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NOTES AND COMMENTS

U.K. Imports and Exports.

Details of imports and exports during 1957, compared with 1956, appear on page 87 of this issue. As C. Czarnikow Ltd.[1] point out, the outstanding point of interest is the increase of nearly half a million tons in the raw sugar intake. Commonwealth exporters contributed some 280,000 tons to this expansion. Queensland figured with an important increase of 160,000 tons, but comparisons can be a little misleading owing to the overlapping which takes place from year to year. Fijian receipts are 58,000 tons higher, while British Guiana supplied 49,000 tons more and Mauritius an additional 42,000 tons. The British West Indies supplied a little more, but South Africa sent 44,000 tons less.

In the full duty group, Cuba added some 60,000 tons to her 1956 total, but there was no change in the tonnage received from the Dominican Republic. Receipts from Brazil of 130,000 tons more reflected the long inoperative period which non-agreement countries enjoyed last year. Peru sent 15,000 tons more, whilst a cargo was received from the Argentine.

Of particular interest is the rise in the imports of overseas white sugar, nearly 40,000 tons, or about 80%, of which came in during the last quarter of the year. Some stock accumulation by manufacturers and distributors in anticipation of an eventual reimposition of the Surcharge was mainly responsible for this jump in receipts.

There was an encouraging recovery in the volume of exports of British refined sugar which, although still 46,000 tons below the 1955 total, were 93,000 tons higher than in 1956. Shipments to Commonwealth countries were lower by 93,000 tons, due in the main to reductions in respect of Malaya and British East and West Africa.

Shipments to the U.S.S.R. and the China Mainland helped to swell the total to foreign destinations, which showed the encouraging expansion of 186,000 tons. Norway again increased her intake of British refined, with an additional 20,000 tons, whilst over 13,000 tons more was taken by West Germany.

U.S. Sugar Consumption in 1957.

The consumption of sugar in the United States during the calendar year 1957, compiled by Willett & Gray, Inc.,[2] covering all refiners, processors and importers, showed a decrease from the 1956 figure of 1·097%.

Based on deliveries to the trade by refiners, beet processors and importers, consumption during 1957 totalled 7,243,522 long tons of sugar, refined value, as compared with 7,323,834 long tons during the preceding year, a decrease of 80,312 tons. These consumption figures are inclusive of deliveries to all U.S. Armed Forces both at home and abroad, but do not include exports in the ordinary commercial trade.

Of the total domestic consumption, cane refiners supplied 4,709,212 tons as against 4,951,366 tons in 1956. The beet processors furnished some 1,780,100 tons, which compares with 1,634,074 tons during the preceding year. No official figure for 1957 could be obtained from the U.S. Beet Sugar Association, but the possibility of constructive deliveries, etc. at year end has been considered in the estimate.

The consumption of white and raw sugar direct to the trade was 754,210 tons compared with 738,394 tons in 1956. There were various changes in origins of supply during the year.

A rather sizeable increase was shown in beet deliveries and a more modest improvement was recorded in the consumption of whites and raws direct to the trade.

On a percentage basis, cane refiners supplied 65·01% against 67·61% in 1956. Beet sugar processors provided 24·58% against 22·31% in the preceding year, while direct consumption suppliers provided 10·41% as opposed to 10·08% in 1956.

By far the largest decrease in total consumption was shown in the port of New Orleans with a fairly sizeable reduction apparent in Atlantic Ports. The Savannah, Galveston and San Francisco figures

[1] *Sugar Review*, 1958, (341), 31–32.
[2] 1958, **82**, 42–44.

for the past two years show only a relatively narrow fluctuation.

The per capita consumption of sugar in the U.S. during 1957 is estimated at 93·90 lb. This estimate is based on a population figure of 172,800,000 as at 1st January 1958, and compares with 96·69 lb per head in 1956 and 93·59 lb in 1955.

The average price of cane refined sugar in New York in 1957 was 8·431 cents per lb with discount and excise tax deducted, as against 8·058 cents in 1956. The average spot price of raw sugar in 1957 was 6·248 cents against 6·089 cents in 1956 on a duty-paid or delivered basis.

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Germany Campaign Results, 1957/58.[1]

The 1957/58 campaign in Germany ended on 11th January with a total beet slice of 10,489,269 tons of average sugar content 15·89%. This compares with 8,300,314 tons worked in 1956/57 containing 15·33% sugar. Sugar production of 1,551,092 metric tons, raw value, included 1,117,461 tons of refined sugar and 309,468 tons of raws. Comparative data from 1956/57 were a total of 1,115,690 tons, raw value, including 836,416 tons of refined and 186,339 tons of raws.

The beet sliced included 485,991 tons of imported beet, the larger part of this coming from Denmark. Danish beet is to be imported on a large scale next campaign, to be worked in the sugar factories of Schleswig-Holstein and Lower Saxony. This beet, on a basis of the 1957/58 average recovery of 14·74%, will have yielded 71,514 metric tons of sugar, raw value, which would otherwise have been imported.

* * *

Hardboard from Cuban Bagasse.[2]

A $3·6m building board plant at Francisco, Camaguey, is expected to be producing hardboard this month. It is to use a process developed by the Taylor Corporation, a New York engineering firm, which is said "to make commercially practicable the manufacture of hardboard from de-pithed bagasse".

* * *

Mauritius Sugar Crop, 1957/58.

A total of 4,343,824 metric tons of cane were crushed in 1957[3], yielding 561,598 metric tons of sugar[4]. These figures compare with 571,893 tons of sugar from 4,421,249 tons crushed in the 1956 crop. Exports during the calendar year 1957 totalled 578,459 metric tons, including 412,870 to the U.K., 87,777 to Canada, 24,624 to Japan, 2286 to Malaya, 457 to Singapore, 12,786 to Hong Kong, 19,697 to Iran, 9144 to Syria, 1016 to the Lebanon, and 7801 to Ceylon. Local sales totalled 23,441 metric tons, tel quel, with 894 tons to the Seychelles.

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National Sugar Refining Co. 1957 Results.

Total melt during 1957 was 1,046,455 short tons compared with 999,591 tons in the previous year. Sales increased from $172m to $187.6m, although net earnings were reduced from $2,558,258 to $2,191,066. Expenditure on improvement and modernization at the New York and Philadelphia refineries between 1946 and 1957 totalled over $20 million and has been designed to increase efficiency, increase output per man-hour, and so reduce the unit cost of product. Illustrated in the report are the automatic control panel for the raw sugar centrifugals at the New York refinery, and a new type of pneumatic bulk sugar trailer of over 30,000 lb capacity which can deliver sugar more than 150 ft along a hose to a customer's storage bin.

I.S.S.C.T.

TENTH CONGRESS, 1959.

The tentative itinerary for the 10th Congress of the International Society of Sugar Cane Technologists, which will be held in Honolulu, Hawaii, during 3rd—22nd May 1959, is taking form. Plans call for the following schedule:—

Sunday, 3rd May—Arrival in Honolulu.

4th May—Registration, Opening Session.

5th, 6th, 7th May—Field delegates will visit the Experiment Station (H.S.P.A.) and sugar plantations on Oahu. Factory delegates will visit the Experiment Station (H.S.P.A.), bulk loading installation, Aiea refinery, and Oahu plantations.

8th—17th May—Factory and field delegates will have separate tours to the islands of Kauai, Maui and Hawaii.

It is estimated that the minimum cost per delegate will be $500, plus transportation to and from Hawaii. This will include hotels, meals, air transportation between islands, local transportation, tours (but not "sightseeing"). Sightseeing tours can be arranged for those delegates desiring same.

The American Express Company, 2388 Kalakaua Avenue, Honolulu, has been designated official travel agents for the Congress. All bookings should be made through them or their local correspondents throughout the world. Reservations should be made as soon as possible.

No restrictions will be placed on the number of delegates at the 10th Congress, within the limits of convention facilities. Early registration is encouraged to assure choice of accommodation and local travel arrangements.

Each Regional Section is limited to five votes in the business sessions, according to W. W. G. Moir, General Secretary-Treasurer. However, he explained this is only for administrative control and in no way limits the total delegation from sugar areas.

[1] F. O. Licht, *International Sugar Report*, 1958, **90**, (1), 3.
[2] *Public Ledger*, 8th February 1958.
[3] Barclays Bank D.C.O., *Overseas Review*, Feb. 1958, 24.
[4] *Mauritius Sugar News Bull.*, 1958, (75), 1.

NEW MECHANICAL CUTTER FOR SEED CANE IN HAWAII

MECHANICAL harvesting of Hawaii's commercial cane has been standard procedure for several years; but, heretofore, seed cane has all been hand cut. Engineer of the Experiment Station of the Hawaiian Sugar Planters' Assn. have now developed a machine which appears to be successfully cutting cane for seeding purposes.

In appearance, the seed cane harvester resembles a conventional crawler-type tractor, surrounded by a network of attachments. A cutting unit, conveyor, and a bin for the cut cane, surround the tractor in a U-shaped assembly.

The cutting device is located to the right of the tractor. A set of revolving blades cut the standing stalks into a maximum of four pieces. The pieces fall on to the conveyor and are carried across the back of the machine and through one blast of air from a blower fan to de-trash the cane. As the seed pieces come off the conveyor they hit a baffle, which also has a blast of air blowing on it. This further removes the loose leaves and other trash. The seed pieces fall by gravity into the bin below.

The bins are portable and can be removed by a top lifting device, or a finger lift. When one bin has been filled, an empty unit is placed on the machine and the operation continues.

It is estimated that the cutter will harvest about 40 tons of seed cane in an eight-hour day.

General specifications of the machine are:—

Overall length, 16 ft 8 in.
Overall width, 17 ft 8 in.
Weight (unloaded), approximately 15 tons.
Gauge, 60 inches.
Tractor unit, Caterpillar D–6 (75 h.p.).
Cutting speed, 1·4 m.p.h.
Max. bin size, 12 ft long, 4 ft wide, 5 ft deep.

The new cutter was first tried at the seed cane nursery of Kohala Sugar Company on the island of Hawaii in the winter of 1957. Indications are that the machine will be put into commercial use by several Hawaiian plantations.

Herbicides for Cane. P. SUAREZ and L. C. SANCHEZ. *Acta Agron.* (*Colombia*), 1956, **6**, 149–158; through *Biological Abstracts*, 1957, Sect. D.—Six different herbicides, in varying concentrations, were tried as pre-emergence and post-emergence treatments in fields planted with sugar cane where about a dozen different weeds, including grasses and a sedge, were common. "Sinox" (sodium–dinitro–orthocresylate at 15–20 lb per hectare, "Santobrite" (pentachlorophenol) at 25 lb per hectare and CMU (*p*-chlorophenyl dimethyl urea) at 4 lb per hectare gave best control in the pre-emergence treatments. CMU at 5 lb per hectare and TCA (sodium trichloracetate) at 40 lb per hectare gave the most effective control as post-emergence treatments. Two months after treatment several weeds and grasses were again growing freely.

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Sugar Beet in Scotland. F. W. SUTTON. *Scottish Agric.*, 1957, **36**, 190–192; through *Biological Abstracts*, 1957, Sect. D.—The methods employed in producing sugar beet in Scotland are compared with those practised in England, the former being based on traditional turnip growing methods. Scottish farmers are said to make use of mechanical aids more readily than English growers. Details are supplied regarding row-width and population and forage value.

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What to Plant ? E. A. PEMBROKE. *Cane Growers' Quarterly Bull.*, 1957, **21**, 30–32.—The characteristics of Q 57, Q 59, Q 64 and Q 66 are detailed.

THE SUGAR CANE IN LOUISIANA

PAPERS READ AT THE 1957 MEETING OF THE AMERICAN SOCIETY OF SUGAR CANE TECHNOLOGISTS

IN the middle twenties the Louisiana sugar industry was nearly wiped out, with an average yield for the State of 6·8 tons cane per acre. The present State average is 23·7 tons—low in comparison with other countries, but the season of growth is very short. That approximately quadrupling of the crop is primarily the consequence of varietal changes. The industry is now faced with a dilemma; mechanical harvesting, owing to the labour position, has come to stay, and mechanical harvesting requires straight, unlodged cane if maximum economy is to be obtained. On the other hand, that second requirement for profitability, a heavier crop, necessarily involves greater liability to lodging. The dilemma is discussed by LLOYD L. LAUDEN.

In the past, new varieties had been released only when they conformed to certain standards laid down by joint agreement between the L.S.U. and U.S.D.A. To meet local specialized conditions, however, one or more of these standards might be waived. Since, in any particular variety, the heavier the crop the greater the liability to lodge, there is a sharp upper limit to yield which is placed at 30–35 tons per acre. N:Co 310 is a border-line cane, capable of giving higher yields, and the suggestion is made that it should be subjected to a controlled extension of area and a period thus obtained for the gradual improvement of the pick-up attachment which now gives satisfaction with straight cane.

Baton Rouge has been added to Canal Point as a source of cane fuzz. This added supply of breeding material raises questions of area needed, and of labour required for seedling propagation on the present basis of singly-planted seedlings. Preliminary trials are being made, in consequence, with the Hawaiian system of bunch planting. The preliminary trials are described in a paper by R. D. BREAUX *et al*, and it appears necessary, owing to the short season, to defer selection to the first stubble crop.

The present outlook in sugar cane insect research is the subject of a paper by W. H. LONG. As illustration of the general trend in the method of approach, the problems of the borer and of soil insects in general are discussed. In the case of the former the three control methods, cultural practices, and biological and chemical control, are reviewed. The first is essentially an inter-crop process, to check the carry-over in the harvest residues; the second covers the release of *Trichogramma* to reduce first generation infestation; and the third covers the later crop period should infestation become heavy. "Endrin", "Toxaphene", "Ryania" and cryolite have all been used.

The studies on soil insects indicate a complex which can only be unravelled slowly. A beginning is only now being made in recording the insect population of soil units of 1 cu. ft. containing a stool. Such knowledge is a preliminary to determining control measures. H. M.-L.

A Study of Low C.C.S. at Babinda. NORMAN J. KING. *Cane Growers' Quarterly Bull.*, 1957, **21**, 23–29. Explanations are offered for the downward trend in c.c.s. observed during the last ten years. One cause is the extended cultivation of Pindar; this should be replaced by Badila, Q 57 and Q 59. Over-burning, the burning of an excessive area on dry days, leading to delay in crushing, is an additional cause, together with excessive dirt resulting from mechanical loading.

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A Comparison of Different Leaf-Sampling Techniques. G. SAMUELS *et al. J. Agric.* (Univ. Puerto Rico), 1957, **41**, 1–9.—Leaf sampling methods for foliar diagnosis differ widely in those countries in which the method has been adopted. When adjustments are made for the different tissues used, the results were found to be in good agreement.

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Fertilizers and Pyrilla Infestation. B. K. SRIVASTAVA. *Madras Agric. J.*, 1957, (44), 190–193.—The results of fertilizer trials with increasing amounts of ammonium sulphate, superphosphate and potassium chloride on populations of cane leaf-hoppers (*Pyrilla* spp.) are given. There was a significant increase in the population of leaf-hoppers with increasing rates of 40–120 lb/acre N, while varying rates of P and K had no effect. Cane leaf-hoppers (notably *Pyrilla pursana*, *P. aberrans* and *P. perpusila*), which suck the juice from the leaves, causing yellowing, are difficult to control for they have various alternative host plants (wild grasses and cereals) on which they may survive after the cane has been harvested, returning to the cane fields with the emergence of the young cane shoots.

* * *

Cane Stem Borer Control in Java. J. RUINARD. *Mededel. Java-Suikerind.*, 1957, (5), 32 pp.—An account is given of trials with various insecticides against stem borers in Java (notably *Proceras sacchariphagus* and *Chilotraea auricilia*), as effective biological methods of control have not yet been found. The larvae must be attacked soon after hatching as they make their way to the soft young parts of the growing cane. Spraying was by knapsack sprayer once a week or every other week for 3–4 months, or until the cane became too tall for such treatment. DDT, BHC, "Toxaphene," "Dieldrin" and "Endrin" gave contradictory results; but cryolite, "Ryania" and derris powder were encouraging and gave 50% or more control, effective applications being 6·7–13·4 lb cryolite or "Ryania" and 0·67–1·34 lb "Rotenone" per acre. It is considered that to treat large areas of infected cane effectively, spraying by aeroplane would be necessary.

Sugar Cane Variety Trials in Puerto Rico, 1951-55. F. MÉNDEZ-ROIG and G. SAMUELS. *J. Agric.* (Univ. Puerto Rico), 1957, **41,** 147–160.—Varieties are compared on the basis of yield of cane per acre, sucrose % cane and tons sugar per acre per month. On the first basis, B 37161, outstanding on East and North Central areas, and PR 980, outstanding on the North-West, West, South and Interior areas, led; on the second, PR 975 and B 4362 took the first two places; on the third, PR 980 with over 0·60 ton sugar per acre per month, led B 37161 with under 0·50 ton. The controls, M 336, POJ 2878 and PR 902, all ranked poorly.

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The Effect of Incorporating Organic Material into a Clay Soil. J. A. BONNET *et al. J. Agric.* (Univ. Puerto Rico), 1957, **41,** 173–177. **The Residual Effect of Filter Press-Cake Applications on Pineapple Yields.** E. HERNÁNDEZ-MEDINA *et al. Ibid.*, 197–201.—In both experiments sugar cane residues were incorporated in the soil. In the former, bagasse depressed corn yields, but filter press-cake gave an increase. Results on other crops are recorded. In the latter, 24–32 tons cake, in combination with 1500 lb of a 12-6-10 fertilizer, applied 30 months before ratoon harvest, gave yields significantly greater than the fertilizer at double the rate.

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The Prevalence of Mosaic and Chlorotic Streak. E. BONETA G. *et al. J. Agric.* (Univ. Puerto Rico), 1957, **41,** 197–200.—Notes are given of the distribution of, and varietal resistance to, the two diseases.

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The Parasites of Sugar Cane Borers and of Clemora Smithi. L. ANDRE MOUTIA. *Rev. Agric. Sucr.* (Mauritius), 1957, **36,** 127–132.—The article is a record of a lecture in which a survey is given of the various parasites which play their part in the biological control of borers and *Clemora*.

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The Finance of Mechanization for Cane Planters. F. TENNANT. *Rev. Agric. Sucr.* (Mauritius), 1957, **36,** 133–137.—In 1953 the Government set aside Rs.1·5m to initiate a Sugar Planters' Mechanical Pool. The terms of membership of the Pool, the implements purchased, the charges for the different classes of work undertaken and the progress made in this co-operative effort are described.

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The Identification of the More Important Sugar Cane Varieties Grown in South Africa. P. G. C. BRETT. *Rpt. S. African Sugar Assoc. Exp. Sta.*, 1957, (4), 23 pp.—The characters used in identification are listed and a key to the varieties based on these is given. Subsequently a description of the several varieties and clear black-and-white illustrations of each are conveniently given on opposed pages.

* * *

Johnson Grass and Corn as Carriers of the Virus of Ratoon Stunting Disease. R. J. STEIB and I. L. FORBES. *Sugar Bull.*, 1957, **35,** 375.—The evidence that both Johnson grass and corn act as carriers of ratoon stunting disease is briefly given. Neither develop symptoms but, in both cases, the juice of plants previously inoculated, when inoculated into sugar cane, produces symptoms in the latter.

CORRESPONDENCE

To the Editor,
The International Sugar Journal Ltd.

THE SUGAR CANE IN MAURITIUS

Dear Sir,

I refer to the agricultural article on "The Sugar Cane in Mauritius",[1] a summary of the Annual Report, Mauritius Sugar Industry Research Institute, 1956, and should like to draw your attention to some errors in the section "Diseases". It is said concerning chlorotic streak that "the possibility of some parasitic agents such as *Cuscuta*, *Cassytha* or *Stenotaphrum* acting as intermediaries is under investigation".

Actually, the experiments described in the report under review relate to the use of a well-known technique for the transmission of virus diseases by means of parasitic phanerogams. In the case of chlorotic streak, the parasites *Cuscuta* and *Cassytha*, which are occasionally found in nature growing on gramineae (including the genus *Stenotaphrum*), are being experimented with to transmit the disease from infected to healthy sugar cane.

I should also like to point out that ratoon stunting disease is considered to be of similar if not greater economic importance than chlorotic streak in Mauritius at present.

Yours faithfully,

P. O. WEIHE,

Director,
Sugar Industry Research Institute,
Mauritius.

[1] *I.S.J.*, 1957, **59,** 333.

THE ACTION OF BROMINE ON THE DIALYSED BROWNING PRODUCTS

from Cane Final Molasses

By W. W. BINKLEY
(New York Sugar Trade Laboratory, 37 Warren Street, New York 7, N.Y., U.S.A.)

THE intense dark colour of cane final molasses is directly attributable to the processing conditions of sugar manufacture. Caramel substances, iron-polyphenol compounds and melanoidins are listed among the principal contributors to this colour[1]. Highly-coloured caramel bodies constitute a minor fraction. The concentration of polyphenol-iron substances varies with the available soluble iron and phenolic groups. Since the concentration of iron in cane final molasses is usually in the range of 60 to 210 p.p.m.[2] the colour resulting from this combination may be significant. The melanoidins or "browning" products are formed from the amino acids and reducing sugars naturally occurring in the juice expressed from sugar cane under the favourable reaction conditions of the manufacturing process. These nitrogen-bearing polymers have been isolated from Florida final molasses and they represent an important fraction of the organic non-sugars in this by-product[3]. Pursuant to our structural studies of these polymers, we wish to report herein the results of certain pertinent bromination studies, with particular emphasis on the implications of the resulting decolorations.

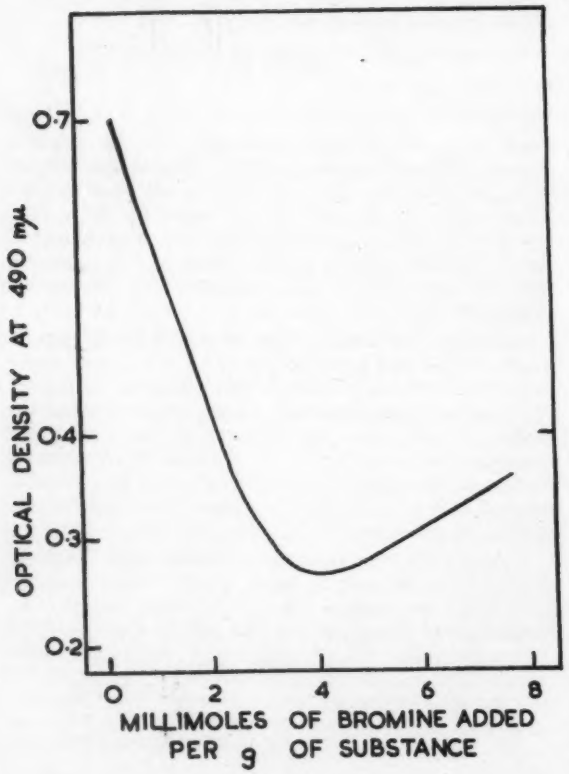

Fig. 1.

EXPERIMENTAL

Bromination of the "Browning" Polymer

Ten milligrams of carefully clarified polymer was dissolved in 50 ml of water (usually the dialysed polymer is substantially, although not completely, clarified by a single pass through a bed of diatomaceous earth). The optical density of this solution at 490 mμ was 0·71. An aliquot (0·1 ml) of saturated bromine water (0·193 *M*) was admixed with the polymer solution. The resulting mixture was allowed to stand for 5 min at 20°C in a dark place and then its optical density at 490 mμ was observed. Four additions in all of bromine were made in this manner; the total bromine added was 7·7 millimoles per gram of polymer. The analytical data are presented in Fig. 1.

Determination of the Bromine consumed by the "Browning" Polymer

(A) *Physical Method.*—Four millilitres of bromine water (0·193 *M*) were admixed with 250 ml of an aqueous solution containing 46 mg of specially clarified polymer (16·8 millimoles of bromine per gram of polymer). A portion of this mixture was poured into a spectrophotometer cell, which was then stoppered tightly. The reaction was allowed to proceed at 20°C in a dark place. The change in optical density at 490 mμ was followed (Curve A of Fig. 2). A few crystals of sodium thiosulphate were dissolved in separate 30 ml portions of the reaction mixture at specified intervals and the optical density at 490 mμ of the resulting partially decolorized solutions were recorded (Curve B of Fig. 2). The values before and after the addition of sodium thiosulphate for the 24-hour reaction period were 0·485 and 0·140, respectively.

[1] ZERBAN: *Sugar Res. Foundation, Tech. Rpt. Series*, 1947, (2).
[2] SATTLER and ZERBAN: *J.A.O.A.C.*, 1952, **35**, 499.
[3] BINKLEY: *I.S.J.*, 1957, **59**, 64.

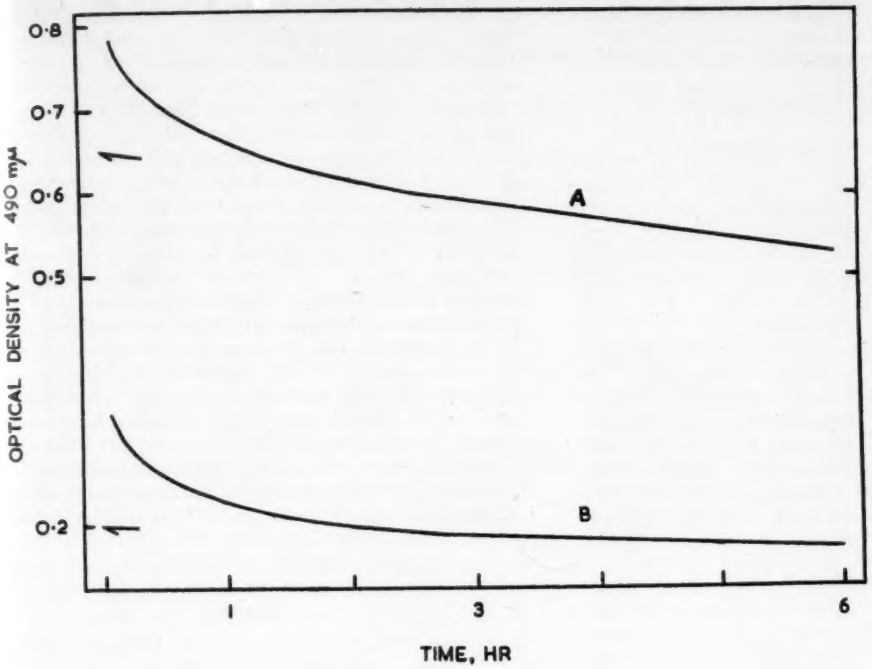

Fig. 2.

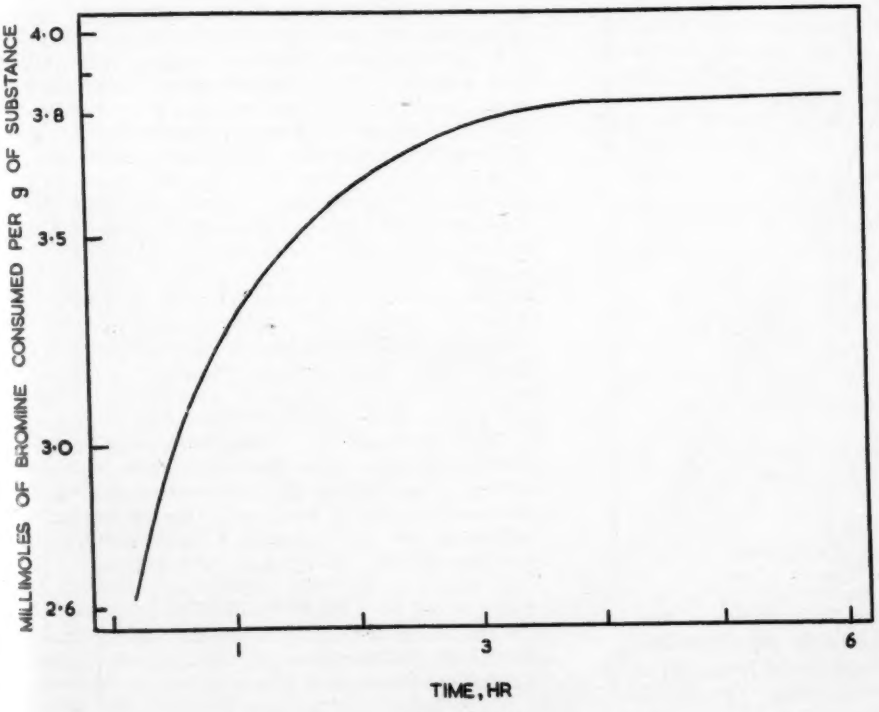

Fig. 4.

A control solution of the reagent alone was prepared and was found to contain 0·77 millimoles of bromine. The data from the measured dilution of this solution with water was used to establish the relationship between the bromine concentration and the optical density at 490 mμ in the range pertinent to this work (Fig. 3).

(B) *Chemical Method* —Fifty ml of bromine water (0·193 *M*) were mixed thoroughly with 50 ml of an aqueous solution of the polymer (500 mg) in a glass-stoppered 100 ml volumetric flask (19·3 millimoles of bromine per gram of polymer) and the resultant mixture was stored at 25–27°C in a dark place. The unreacted bromine was determined at specified intervals by withdrawing rapidly 4 ml aliquots of the reaction mixture. These were added at once to a solution composed of 5 ml each of aqueous *N* potassium iodide and a sodium acetate–acetic acid buffer (10 g sodium acetate trihydrate, 10 ml glacial acetic acid and 80 ml of water). The liberated iodine was determined with 0·1 *N* sodium thiosulphate; the indicator was starch. A control experiment with bromine alone was performed in an identical manner. The rate of bromine consumption by the polymer is plotted in Fig. 4; the points shown were corrected for the losses established by the control experiment. Four-

millilitre aliquots of the reaction mixture and control experiment required 4·84 and 6·40 ml of 0·1 *N* sodium thiosulphate, respectively, for the 24-hr reaction period; 3·9 millimoles of bromine had been consumed for each gram of polymer.

Results and Discussion

Bromination conditions conducive to simple addition reactions with unsaturated groups were chosen for this investigation, namely 20–27°C temperatures and the exclusion of light and catalysts. The change in optical density (decoloration) of the molasses polymer solution with the incremental addition of bromine indicated the rapid consumption of approximately 4 millimoles of bromine per gram of polymer (Fig. 1). The rate of reaction of the polymer at 20°C with a large excess of bromine (Curve A of Fig. 2) revealed that the primary reactions were largely finished in 120–150 min. Much slower and less significant secondary reactions were observed during the following 22 hr. Polymer decoloration was concurrent with bromine consumption. The course of this colour change was followed by the removal of the unused bromine with sodium thiosulphate (Curve B of Fig. 2, optical density of decolorized polymer). Extrapolation of these curves to zero time showed that the optical densities of the reaction mixtures before and after the removal of the excess bromine were 0·65 and 0·20, respectively, at the completion of the primary reactions. The difference between these values, 0·45, represented the optical density of the colour from unreacted bromine. This figure was found to be equivalent to 73% of the quantity of this halogen admixed originally with the polymer (Fig. 3), 27% of the bromine being consumed. This physical method indicated that 1 g of the dialysed molasses browning products had reacted with 4·5 millimoles of bromine; the value obtained by a chemical procedure was 3·8–3·9 (Fig. 4). The second value may be slightly less exact than the first one because of the repeated opening of the reaction vessel during the determination of the rate curve shown in Fig. 4. The polymer underwent 72% decoloration when the optical density of its solution changed from 0·71 to 0·20 during the primary bromine reactions.

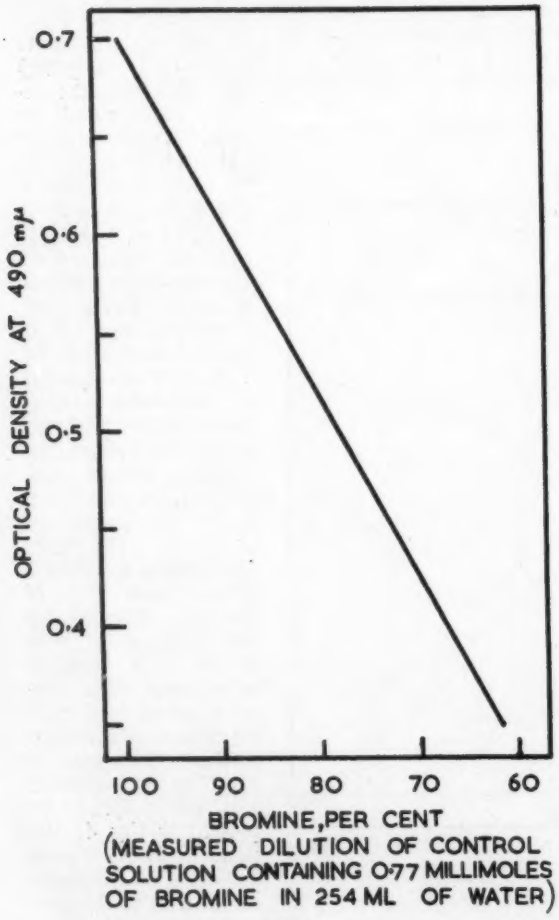

Fig. 3.

The empirical formula for the repeating unit of the "browning" polymer in Florida cane final molasses, $C_{17-18}H_{26-27}O_{10}N$, was deduced previously[4]. While the radio-tracer studies of a *D*-glucose-glycine "browning" polymer indicated that the hexose carbon skeleton had remained intact[5], the high yield of hexitols among the hydrogenolysis products from the molasses polymer revealed that many of these six-carbon units had retained their original hydroxyl groups (either as such or in a regenerable form)[3]. A logical precursor to this repeating unit would be the corresponding *N*-glycosyl amino acid residue, $C_{17}H_{30}O_{12}N$. The difference between this formula and that of the polymer unit was two molecules of water. This loss would be expected to introduce unsaturated groups, such as >C=C<, >C=O and >C=N—. They are important in colour production. The saturation of these groups by either hydrogenation or bromination usually markedly reduces their colour contribution. These processes effected up to 72% diminution of the molasses polymer colour. This consumption of 3·9–4·5 millimoles of bromine per gram of polymer indicated the probable presence of 1·6–1·8 unsaturated groups in its repeating unit.

Summary

The bromination of the "browning" polymer from the cane final molasses under conditions favouring addition reactions revealed the probable presence of 1·6–1·8 unsaturated groups per polymer repeating unit and caused a 72% diminution in the polymer colour.

Acknowledgment

The writer wishes to thank Mr. James Martin, of this Laboratory, for his assistance in a portion of the experimental work.

[4] Binkley: *I.S.J.*, 1957, **59**, 178.
[5] Wolfrom *et al.*: *J. Amer. Chem. Soc.*, 1953, **75**, 1013.

THE EFFECT OF BASIC LEAD ACETATE SOLUTION

Upon the Optical Rotation (Polarization) of Solutions of Sucrose, Levulose and Dextrose and of various mixtures of these Solutions

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SUMMARY

THE work of BATES and BLAKE has been repeated and extended to levulose and dextrose and sucrose solutions containing amounts of these two sugars equivalent to those found in raw sugars. Whilst the shape of the sucrose curve has been broadly confirmed, the extent of the initial dip has been found to be much smaller. With the mixed sugars the sucrose effect predominates. There is reason to believe that the usual reaction between the lead solution and levulose in those solutions containing sucrose is suppressed by the sucrose.

The correction of commercial polarizations of raw sugars for lead effect is discussed with respect to these results.

INTRODUCTION

At a meeting between a special sub-committee of the British National Committee of ICUMSA and representatives of the Commonwealth sugar producing companies[1] a comprehensive study dealing particularly with the effects of the basicity of the lead reagent and with the non-linearity of the lead effect was presented. A substantial portion of that document was devoted to reporting the preliminary results of a study of the effects of varying amounts of basic lead acetate solution on the optical activity (polarization) of solutions of sucrose, levulose and dextrose, and various mixtures thereof, and it is the purpose of this paper to describe the results obtained.

BATES and BLAKE[2] in 1907 investigated these effects with respect only to solutions of sucrose with the particular purpose of showing that the lead effect, whilst small, could not be neglected when considering the polarizations of raw sugars, although they regarded the effect with sucrose as secondary to the effect with levulose. They found that small amounts of the lead solution depressed the polarization of a "normal" sugar solution (polarization 99·90°V), the greatest depression being 0·13°V after additions of between 1 and 2 ml of lead and that thereafter the polarization increased steadily reaching 99·90°V, at 6 ml and finally rose to nearly 101°V at 63 ml. Their paper gives the specific gravity of their lead solution and the statement that when titrated with acid it gave approximately the theoretical amount of dissolved lead oxide. The number of their observations between additions of 0 and 1 ml, a part of the investigation which is of great interest at present, was limited to two, one at 0·5 ml and the other at 1·0 ml. No observations were made on sucrose solutions containing small amounts of levulose and dextrose equivalent to those found in raw sugars. There is therefore good reason to repeat the investigation of BATES and BLAKE at the present time and to extend it to include mixtures of sucrose with other sugars. Finally, an experiment is described which demonstrates the ability of "normal" sucrose solution to inhibit the normal ionic reactions of lead in solution.

When this reagent is added to a sucrose solution a turbidity is produced, sometimes at once, sometimes after a little standing. Its amount is inconsiderable, but it cannot be removed by filtration even through fine papers. BATES and BLAKE, who added a lead sulphate cream of known composition to assist filtering, also stated that its formation could be avoided by using water free from carbonates and avoiding too great a dilution of the mixed sugar and lead subacetate solution. Whilst the precipitate has been identified as basic lead carbonate, which confirms the above statement, it was decided to accept its formation, rather than avoid it, as it was thought desirable for comparison purposes to follow as far as possible normal polarimetric technique for raw sugars. It was found that clear solutions could be obtained by centrifuging the turbid solutions, and a technique which avoided any evaporation losses was developed. In consequence, it was possible to make a study of the effect of small additions of basic lead acetate over the range of addition of 0 to 6·0 ml of lead and 20·0 ml, at intervals of 0·1 or 0·2 ml, on the polarizations of the following solutions:—

(A) "Normal" sucrose solution 26 g/100 ml,
(B) Seven concentrations of levulose from 0·025 g/100 ml to 2·000 g/100 ml,
(C) Three concentrations of dextrose, 0·10, 0·20 and 0·50 g/100 ml,
(D) Three concentrations of levulose and dextrose each being present to the extent of 0·10, 0·20 and 0·50 g/100 ml,
(E) Two "normal" solutions of sucrose containing respectively 0·05 g and 0·10 g/100 ml of levulose, and
(F) One "normal" solution of sucrose containing 0·10 g/100 ml each of levulose and dextrose.

METHOD

Materials

Sucrose—Pure sucrose supplied by Tate & Lyle Ltd., Plaistow Wharf.
Levulose—B.D.H. laboratory reagent.
Dextrose—B.D.H. "Analar" reagent.

[1] *I.S.J.*, 1957, **59**, 156.
[2] *Bull.* (Nat. Bur. Standards), 1907, **3**, 105.

Basic lead acetate solution—Powdered basic lead acetate (B.D.H. "Analar" reagent conforming to A.C.S. specification) dissolved in freshly boiled and cooled distilled water and the specific gravity of the solution adjusted to 1·25. The ratio of basic lead to total lead (basicity) in this reagent when freshly prepared was 0·46 (basic Pb 10·9 g/100 ml; total Pb 23·5 g/100 ml).

Apparatus

Flasks—Selected 100 ml sugar flasks (B.S.675) of actual volume 100·00 ± 0·01 ml.

Pipettes for lead addition—N.P.L. Grade A.

Polarimeter—Schmidt & Haensch polarimeter with engraved sugar scale for use with mercury green light (5461 A). Readings to 0·025°S were reproducible and an experienced observer could match fields to a somewhat greater accuracy.

Polarimeter tube—End filling 200mm tube with metal end caps.

Cover glasses—Only two used having tested plane parallel faces, the glass showing no optical activity.

The filled tube when placed in the polarimeter trough always occupied the same position.

Sucrose Experiments

The usual polarimetric technique for raw sugars was used so far as this was applicable. 26 g (±0·2 mg) sucrose was weighed out in a nickel scoop and washed into a sugar flask with cooled, freshly boiled, distilled water. The contents of the flask were mixed until the sugar was dissolved and further water added to bring the volume to about 60 ml. The appropriate amount of lead solution was then added, the neck of the flask washed down, and the contents diluted to about 90 ml. After mixing, the temperature was adjusted to 20°C and the solution made up to the mark, water adhering to the neck of the flask being removed with a rolled filter paper. After a thorough shaking the solution was then allowed to stand for 1–2 hours to allow any turbidity to develop fully.

An 11 cm centrifuge tube (50 ml) was twice rinsed with the solution, after which 25 ml was put in it and the tube closed with a cork protected from contact with the sugar solution by a piece of polythene sheet, which stoppering avoided evaporation from the solution. The tube was spun in the centrifuge for 5 min at 2500 r.p.m. The clear solution was then decanted and after adjusting its temperature to 20°C was used to fill the polarimeter tube, which was allowed to remain in the trough of the polarimeter for at least 5 min at 20°C before any reading was made. A second portion of the original solution was similarly cleared and read. At a later date the entire programme was repeated so that, in all, four readings were obtained for each lead level. Blank determinations were run each day on pure sucrose solutions which made it possible to refer all readings to 100·00°S. Instrumental fluctuations were recorded by reading an N.P.L. calibrated standard quartz plate throughout the period of observations.

Levulose and Dextrose Experiments

Solutions of these sugars (usually 1 or 2%) were prepared and appropriate amounts pipetted into sugar flasks to give solutions eventually containing 0·025, 0·05, 0·10, 0·20, 0·50, 1·00 and 2·00 g of levulose per 100 ml, and 0·10, 0·20 and 0·50 g of dextrose per 100 ml. Mixtures containing 0·10, 0·20 and 0·50 g each of levulose and dextrose per 100 ml were also examined.

At the higher concentrations of levulose no turbidity was encountered when the lead solution was added and these solutions could be read directly. In other cases, notably with all concentrations of dextrose and very dilute solutions of levulose, the particle size of the turbidity was extremely fine and the turbidity could not be separated in the centrifuge. On some occasions an apparently clear solution exhibited scattering of light when examined in the polarimeter and again no readings could be made.

As with the sucrose work, a daily blank determination was made using the pure sugars or mixtures thereof and a similar instrumental control established by use of the quartz plate.

Sucrose, Levulose and Dextrose Experiment

The solution contained 26·00 g of sucrose and 0·10 g each of levulose and dextrose per 100 ml. The levulose and dextrose additions were made after the sucrose had been dissolved and before the addition of the lead reagent. A mixture of the above composition was used for the blank determination.

Results

Table I

Polarizations of Sucrose and Sucrose Mixtures

Lead added (ml)	*A*	*B*	*C*	*D*
0·0	100·00	99·75	99·50	99·76
0·1	99·98	—	—	—
0·2	99·95	99·745	99·49	99·77
0·3	99·95	—	—	—
0·4	99·975	99·71	99·475	99·74
0·5	99·975	—	—	—
0·6	99·98	99·70	99·46	99·76
0·7	99·97	—	—	—
0·8	99·95	99·72	99·47	99·755
0·9	99·96	—	—	—
1·0	99·995	99·75	99·47	99·77
1·1	99·99	—	—	—
1·2	99·98	99·74	99·49	99·76
1·3	99·99	—	—	—
1·4	99·98	99·755	99·50	99·78
1·5	99·99	—	—	—
1·6	100·00	99·76	99·52	99·79
1·7	100·00	—	—	—
1·8	99·995	99·79	99·52	99·80
1·9	100·005	—	—	—
2·0	100·00	99·78	99·53	99·775
3·0	100·025	99·825	99·595	99·85
4·0	100·04	99·86	99·655	99·885
5·0	100·055	99·88	99·69	99·96
6·0	100·075	99·92	99·74	100·05

A contained sucrose (26 g/100 ml)
B contained sucrose (26 g/100 ml) + levulose (0·05 g/100 ml)
C contained sucrose (26 g/100 ml) + levulose (0·10 g/100 ml)
D contained sucrose (26 g/100 ml) + levulose (0·10 g/100 ml) + dextrose (0·10 g/100 ml)

Each figure represents average of four separate determinations.

Fig. 1 shows the curves which relate the polarization with the amounts of added lead solution for sucrose solutions and for sucrose solutions containing the other sugars. It will be observed that all four curves have a broadly similar appearance. Initially the polarization drops slightly below the polarization of the pure sugar solution and then subsequently rises steadily, returning to the initial figure when somewhere between 1 and 2 ml of lead solution has been added. For sucrose alone, this point approaches 2 ml, whilst for the sucrose–levulose mixtures it is nearer 1 ml. In the sucrose–levulose–dextrose curve the initial dip is not certainly shown but the polarization commences to rise steadily after about 1 ml of lead has been added.

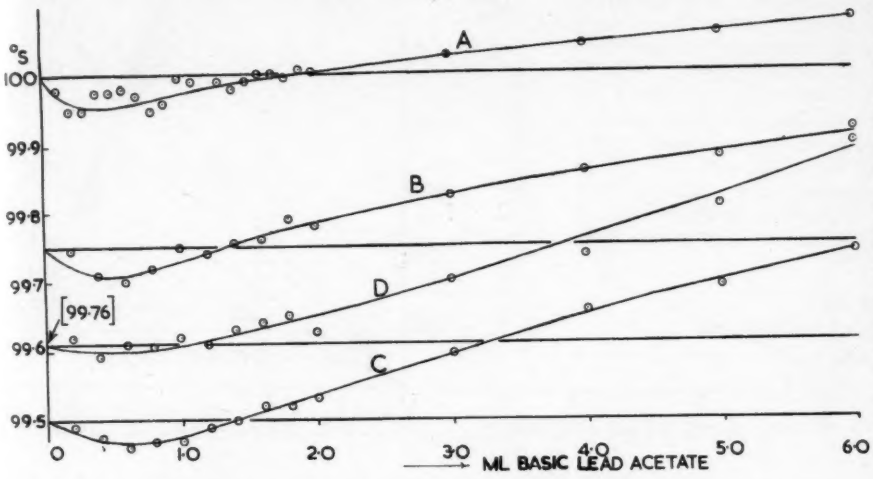

Fig. 1.

Variation in polarization with added basic lead acetate solution of solutions of sucrose with other sugars. (Note curve D is plotted 0·15°S low).

It is to be noted that in the sucrose curve the observations for lead additions below 1·5 ml show a degree of scatter which makes the drawing of a smooth curve an operation of some difficulty. Repeated observations at these points do not help to resolve this difficulty. With the addition of 0·05% of levulose this scatter is reduced somewhat, whilst with the addition of 0·10% of levulose abnormal scatter is nearly absent. With dextrose present in addition to the levulose the scatter is once again apparent. Thus, although it may be said that most of the observations in the initial parts of three of the curves (omitting the solution containing dextrose) are lower than the initial values, there is some degree of uncertainty as to whether they can be regarded as lying on a smooth curve. It is, for example, by no means certain that there is not a rise and fall at the bottom of the dip in the sucrose curves (see Fig.1). A similar scatter appears in the original work of BATES and BLAKE who, however, recorded a dip of much longer duration.

Fig. 2 shows on the left the curves relating polarization and added lead for a number of small concentrations of levulose; whilst, on the right, these observations are plotted as elevations (diminution of laevo-rotation) above the polarizations of the pure sugar solution. It is apparent from the elevation

Table II. Polarization of Levulose Solutions.

Lead added (ml)	Concentration of Levulose (g/100 ml) 0·025	0·05	0·1	0·2	0·5	1·0	2·0
0·0	—0·125	—0·255	—0·515	—1·03	—2·575	—5·15	—10·30
0·1	—	—	—	—1·015	—	—	—
0·2	—0·10	—0·205	—0·475	—1·00	—2·525	—5·09*	—10·24*
0·3	—	—	—	—0·99	—	—	—
0·4	—0·075	—0·17	—0·455	—0·98	—2·475	—5·04*	—
0·5	—	—	—	—0·965	—	—	—
0·6	—0·05	—0·12	—0·415	—0·95	—2·425	—4·975*	—10·125*
0·7	—	—	—	—0·93	—	—	—
0·8	—0·025	—0·09	—0·415	—0·90	—2·375	—4·925*	—
0·9	—	—	—	—0·89	—	—	—
1·0	—0·025	—0·07	—0·39	—0·88	—2·325	—4·875*	—10·075*
1·2	0·00	—0·055	—0·375	—0·84*	—	—	—
1·4	—0·025	—0·04	—0·34	—0·79*	—	—	—
1·6	—0·025	—0·03	—0·325	—0·755*	—	—	—
1·8	—	—0·02	—0·305	—0·74*	—	—	—
2·0	—0·015	—0·005	—0·29	—0·69*	—2·085	—4·60*	—9·71*
3·0	—	+0·02	—0·145	—0·54*	—1·91*	—4·35*	—
4·0	—	+0·03	—0·065*	—0·405*	—1·685*	—4·075*	—9·125*
5·0	—	—	—0·005	—0·29*	—1·54*	—3·84*	—
6·0	—	+0·045	+0·035*	—0·205*	—1·325*	—3·60*	—8·525*
20·0	+0·10	+0·10	+0·225*	+0·33*	+0·185*	—1·21*	—5·075*

Each figure represents average of two determinations.
* No turbidity produced on addition of basic lead acetate solution.

plot that with the lowest concentrations of levulose the effect of lead is to reduce fairly rapidly the laevo-rotation of the levulose. However, between concentrations of 0·05 and 0·10 g/100 ml of levulose there is a change and the reduction of the laevo-rotation of the levulose by the lead proceeds much more slowly. This variation in behaviour is better demonstrated by plotting elevation of polarization against concentration of levulose for a number of different lead additions (Fig. 3). From this it will be seen that at each lead level the reduction of laevo-rotation proceeds rapidly at first, the reduction being greatest at a concentration of 0·05 g/100 ml of levulose; then the reduction diminishes and finally increases again but more slowly than originally. The dip in the curve is at its lowest at a concentration of 0·2 g/100 ml for a lead addition of 0·2 ml lead, and this dip moves to the left as the lead additions increase until at an addition of 1·6 ml of lead it appears at a concentration of 0·1 g/100 ml of levulose. In interpreting the curves of Fig. 3 it must be remembered that the actual polarizations are dropping rapidly.

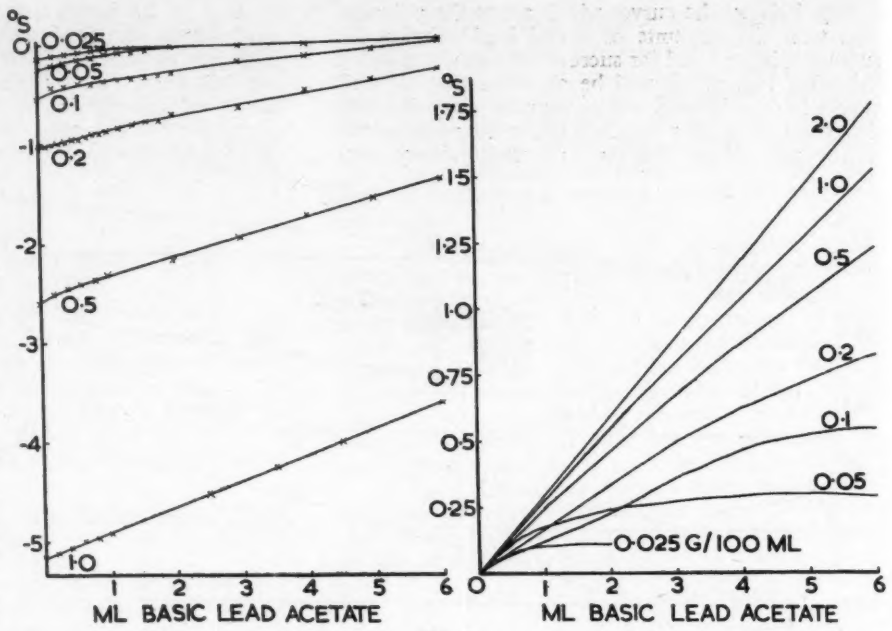

Fig. 2.

(*a*) Effect of the addition of basic lead acetate solutions upon the polarization of various concentrations of levulose.

(*b*) Elevations of polarization plotted against increasing lead addition.

The addition of lead solution to all solutions of dextrose produced precipitates which were not successfully removed.

Mixtures of levulose and dextrose containing 0·10, 0·20 and 0·50 g/100 ml of each sugar were successfully examined, and the results appear in Fig. 4. It will be seen that elevations of polarization above the value for the pure sugar solution are much the same for the mixtures of the two sugars as they are for the corresponding levulose solution, and only at the higher concentration is this elevation reduced by about one-fifth.

Table III. Elevation of Polarizations of Levulose Solutions.

Lead added (ml)	Concentration of Levulose (g/100 ml)						
	0·025	0·05	0·1	0·2	0·5	1·0	2·0
0	0	0	0	0	0	0	0
0·1	—	—	—	0·015	—	—	—
0·2	0·025	0·05	0·04	0·03	0·05	0·06	0·06
0·3	—	—	—	0·04	—	—	—
0·4	0·05	0·085	0·06	0·05	0·10	0·11	—
0·5	—	—	—	0·065	—	—	—
0·6	0·075	0·135	0·10	0·08	0·15	0·175	0·175
0·7	—	—	—	0·10	—	—	—
0·8	0·10	0·165	0·10	0·13	0·20	0·225	—
0·9	—	—	—	0·14	—	—	—
1·0	0·10	0·185	0·125	0·15	0·25	0·275	0·225
1·2	0·125	0·20	0·14	0·19	—	—	—
1·4	0·10	0·215	0·175	0·24	—	—	—
1·6	0·10	0·225	0·19	0·275	—	—	—
1·8	—	0·235	0·21	0·29	—	—	—
2·0	0·11	0·215	0·225	0·34	0·49	0·55	0·59
3·0	—	0·275	0·37	0·49	0·665	0·80	—
4·0	—	0·285	0·49	0·625	0·89	1·075	1·175
5·0	—	—	0·51	0·74	1·035	1·31	—
6·0	—	0·30	0·55	0·825	1·25	1·55	1·775
20·0	0·225	0·355	0·74	1·36	2·76	3·94	5·225

Discussion

It will be convenient to consider first the effects of the lead reagent on levulose. It is apparent that for the lower concentrations (0·025 and 0·05 g/100 ml

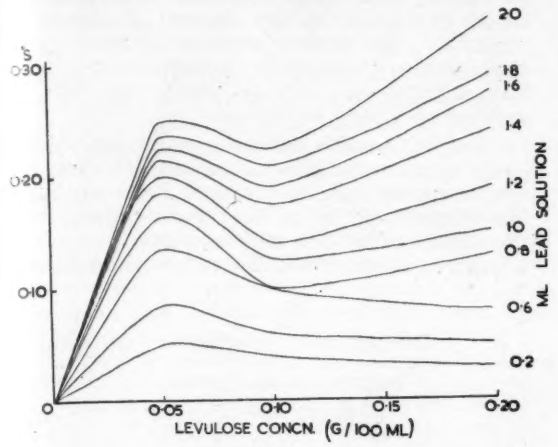

Fig. 3.
Effect of varying concentration of levulose upon the elevations in polarization due to various amounts of basic lead acetate solution.

of levulose) the fairly rapid loss of optical activity (diminution of laevo-rotation) must be associated with the removal of the levulose presumably as the

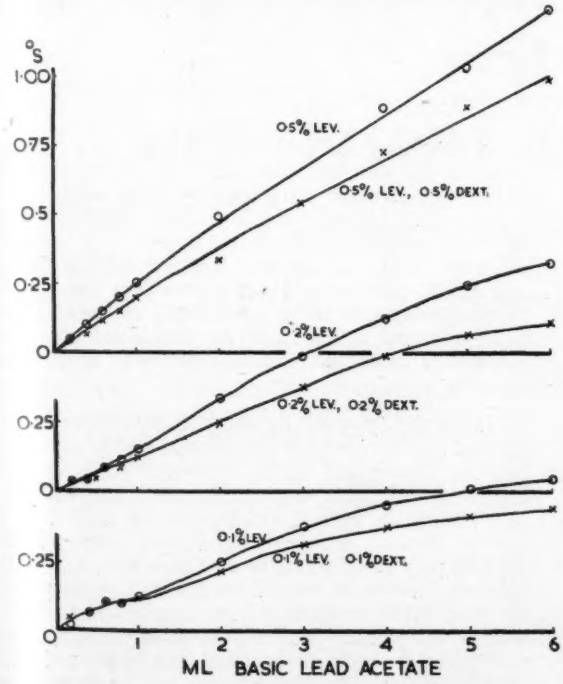

Fig. 4.
Elevation of polarization plotted against lead addition for various concentrations of levulose and levulose + dextrose.

lead salt. The curve for 0·025 g/100 ml (Fig. 2 right) rises fairly rapidly up to a lead addition of 0·8 ml and then flattens out. Similarly with the 0·05 g/100 ml concentration, which flattens out after the addition of about 2·0 ml. The curves for subsequent concentrations 0·1 g and upwards do not rise so quickly and only the 0·1 and 0·2 g curves show any signs of flattening after the addition of several ml of lead reagent. The change in behaviour at the earlier lead additions is presumably associated with more of the levulose being retained in solution and therefore increasing the laevo-rotation, that is to say, the lead levulose compound is dissolving in the excess levulose. These changes are demonstrated by the curves in Fig. 3. The ability of levulose to dissolve lead levulosate has been described,[3,4,5,6] as has its ability to dissolve lead carbonate.[7] This agrees with our observation that the turbidity produced by the initial

Table IV

Polarization of Dextrose Solutions

Concentration of Dextrose	Polarization (no lead)	Effect of Lead Additions
0·1 g/100 ml	+0·30	Solutions unreadable
0·2 g/100 ml	+0·625	Solutions unreadable
0·5 g/100 ml	+1·30	No apparent effect up to 1 ml. Difficult to read.

Table V

Polarizations of Mixtures of Levulose and Dextrose

Lead added (ml)	Concentrations of Levulose and Dextrose (g/100 ml of each) 0·1	0·2	0·5
0·0	—0·24	—0·50	—1·09
0·2	—0·19	—0·475	—1·05
0·4	—0·17	—0·45	—1·025
0·6	—0·14	—0·425	—0·975
0·8	—0·14	—0·39	—0·925
1·0	—0·13	—0·35	—0·875
2·0	—0·025	—0·26	—0·75
3·0	+0·075	—0·12	—0·55
4·0	+0·14	—0·01	—0·36
5·0	+0·175	+0·065	—0·225
6·0	+0·20	+0·14	—0·10

Each figure represents average of two determinations.

Table VI

Elevation of Polarizations of Levulose and Dextrose

Lead added (ml)	Concentrations of Levulose and Dextrose (g/100 ml of each) 0·1	0·2	0·5
0·0	0	0	0
0·2	0·05	0·025	0·04
0·4	0·07	0·05	0·065
0·6	0·10	0·075	0·115
0·8	0·10	0·11	0·165
1·0	0·11	0·15	0·215
2·0	0·215	0·24	0·34
3·0	0·315	0·38	0·54
4·0	0·38	0·49	0·73
5·0	0·415	0·565	0·865
6·0	0·44	0·64	0·99

[3] Gill: *Z. Ver. deut. Zuckerind.*, 1871, **21**, 257.
[4] Winter: *Annalen*, 1888, **244**, 320.
[5] Strocchi and Gleozzi: *Annali Chim.*, 1951, **41**, 689–696.
[6] Doss and Vishnu: *Sugar*, 1956, **51**, (11), 34, 51.
[7] von Lippman: "Die Chemie der Zuckerarten" 1904, 883.

addition of lead does not occur with the higher concentrations of levulose. The formation of a dextro-rotatory compound of lead and levulose has been confirmed.

The addition of an equal small concentration of dextrose to the levulose solution reduces the laevo-rotation by an amount approximately equal to the dextro-rotation of the dextrose. The further addition of various amounts of lead up to 1 ml does not modify the amount of this reduction up to a concentration of 0·20 g/100 ml, and it is reasonable to conclude that for these concentrations any reaction between dextrose and lead reagent in the presence of levulose produces no significant change in the optical activity of the solution. The following table demonstrates this point:—

follows: To a 26 g/100 ml solution of sucrose add 10 ml of 10% sodium sulphate, followed by one or two ml of basic lead acetate. No precipitate is found, apart from the normal slight turbidity (basic lead carbonate) which appears when lead solution is added to sucrose in the absence of any sodium sulphate. The further addition of more sodium sulphate also produces no precipitate and in fact lead sulphate can only be precipitated from this solution by adding acetic acid.

There is a notable difference in the size of the dip in the sucrose–lead curve as found in this investigation compared with the results of BATES and BLAKE. They found a dip below the original polarization of the sucrose solution continuing until 6 ml of lead solution had been added. The new work only records

Table VII

Lead (ml)	Concentration Levulose g/100 ml	Observed Pol. of Levulose °S	Concentration Dextrose g/100 ml	Observed Pol. of Levulose +Dextrose °S	Reduction of Pol. due to Dextrose °S	Observed Pol. of Dextrose °S
Nil	0·10	—0·515	0·10	—0·240	0·275	0·300
0·2	0·10	—0·475	0·10	—0·205	0·270	
0·4	0·10	—0·455	0·10	—0·180	0·275	
0·6	0·10	—0·415	0·10	—0·155	0·260	
0·8	0·10	—0·415	0·10	—0·155	0·260	
1·0	0·10	—0·390	0·10	—0·130	0·260	
Nil	0·20	—1·030	0·20	—0·500	0·530	0·625
0·2	0·20	—1·000	0·20	—0·475	0·525	
0·4	0·20	—0·980	0·20	—0·450	0·530	
0·6	0·20	—0·950	0·20	—0·425	0·525	
0·8	0·20	—0·900	0·20	—0·390	0·560	
1·0	0·20	—0·880	0·20	—0·350	0·530	
Nil	0·50	—2·575	0·50	—1·090	1·465	1·500
0·2	0·50	—2·525	0·50	—1·050	1·475	
0·4	0·50	—2·475	0·50	—1·025	1·450	
0·6	0·50	—2·425	0·50	—0·975	1·450	
0·8	0·50	—2·375	0·50	—0·925	1·450	
1·0	0·50	—2·325	0·50	—0·875	1·450	

It will be seen that at the highest concentration, 0·50 g/100 ml, the reduction in laevo-rotation due to the dextrose is slightly greater than five times the reduction at 0·10 g/100 ml, whereas at 0·20 g/100 ml the reduction is almost exactly double that for 0·10 g/100 ml. It is also observed that the reductions due to dextrose in the mixed sugars containing no lead are slightly lower than the actual polarization of the pure dextrose solution.

Considering the curves for the sucrose-containing solution it is apparent that it is the characteristics of the sucrose curve that are broadly repeated; for example, the curve for sucrose containing 0·1% levulose cannot be reproduced by adding the figures for sucrose alone and 0·1% levulose alone. In fact, the major difference due to the levulose is an increase in the rate at which the polarization increases after the addition of 2·0 ml of lead. It appears therefore that the normal laws of mass action are obeyed; that is to say that in those solutions where the sucrose is molecularly many times in excess of the levulose, reaction between the lead and the levulose is largely suppressed.

This ability of sucrose to suppress the normal ionic reaction of lead salts may be demonstrated as a dip extending as far as the addition of 2 ml. In view of the difference in technique the method of BATES and BLAKE using added lead sulphate to eliminate the turbidity has been used, but the results obtained agreed with the latest figures. The absence of exact details of the lead solution used by BATES and BLAKE makes an exact comparison impossible, but assuming that there is no other factor that has been overlooked, it must be concluded that the differences found are due to differences in the lead reagent.

The steady rise in the sucrose curve after 0·5 ml of lead has been added can be reasonably explained by the assumption of a lead–sucrose compound dissolved in excess sucrose, the resultant combination having an optical activity greater than that of sucrose alone. Further the sharper slope of the sucrose plus levulose curve can be explained by the ability of the levulose with its known solvent power for lead salts to assist in the solution of the lead sucrose compound. Why this solution process, either with sucrose or levulose, does not start with the initial addition of lead is not clear. It may well be that until sufficient lead has been added the reaction between lead and sucrose is incomplete or that any

compound formed fails to attract the excess sucrose. Such an uncertainty would explain the unusual scatter found in the sucrose results and also the decrease in the scatter as the concentration of the levulose, with its lead salt solvent power, increases. Nevertheless, a complete explanation of the dip in the sucrose curve has still to be found.

Finally, the relationship between this work and the determination of the polarization of raw sugars must be considered. The concentrations of levulose and levulose–dextrose which were added to the sucrose were deliberately selected as being representative of the sugar composition of many raw sugars. It has been demonstrated that for these mixtures it is the lead–sucrose relationship which has to be considered and that the lead–levulose reaction is largely if not completely suppressed. Inspection of the curves shows that the area of observation used by nearly all sugar analysts falls within the dip of the pure sugar curve below 100°S or of the sugar mixtures below their known absolute values. Thus any polarization obtained within this area is necessarily lower than the absolute value. Further, the optical rotation of the main constituent is itself varying and the variations are in different directions, whilst the extent of this area of change is governed by the composition of the sugar mixture. It would therefore appear that any attempt to bring uniformity into polarization determinations by using corrections based on a technique demanding the minimum use of lead reagent is foredoomed to failure. Such corrections would indeed be generally unacceptable.

Conclusions

(1) The general shape of the sucrose–lead curve, as described by Bates and Blake, has been confirmed. Differences in the size of the initial dip can presumably be ascribed to differences in the lead reagents used.

(2) The sucrose–lead characteristic remains the predominating one when other sugars are added in small quantity to the sucrose.

(3) From dilute solutions of levulose, basic lead acetate precipitates a lead levulosate which will dissolve in excess levulose.

(4) The ability of sucrose to suppress the normal ionic reactions of lead has been demonstrated.

(5) Analytical methods for sugar involving clarification by lead solution, which rely on the normal ionic reagents for the removal of excess lead, should be studied in the light of the preceding conclusion.

(6) The correction of raw sugar polarization for lead effect is clearly a matter of some complexity and cannot at present be regarded as a feasible proposition.

Acknowledgments

The authors wish to thank Messrs. Tate & Lyle Ltd. for a supply of pure sucrose from their Plaistow Refinery, and Dr. G. M. Bennett, the Government Chemist, for much helpful criticism and for permission to publish this paper.

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THE "SPALDINLAB" SUGAR-TEKTOR

AN APPARATUS FOR THE AUTOMATIC DETECTION OF TRACES OF SUGAR IN BOILER FEED WATERS, CONDENSERS, Etc.

By Wm. H. PARKER, M.Sc., and G. M. BOND (Chemical Control Service, British Sugar Corp. Ltd.)

THE triphenyl tetrazolium chloride method for determination of invert sugar lends itself well for use in the mechanized detection of boiler feed entrainment. The mechanical dosing of sulphuric acid as used in the usual Molisch test presents difficulties, is unpleasant to handle, and is also rather costly.

In the TTC method the precipitate of formazan produced is dissolved in isopropyl alcohol and the depth of colour formed is measured to arrive at the invert content of the sample. Isopropanol is expensive and is risky to use near a flame. In addition, the colour strength of the resultant amber-red solution would be difficult to measure when using a photo-cell having its peak output at least one octave lower than visible red. After considerable experimentation, the method finally adopted was to precipitate the formazan in a finely divided state and to use this precipitate direct to operate a photo-cell using nearly white light. The amount of precipitate formed is, of course, proportional to the amount of invert present in the sample.

The general arrangement shown in Fig. 1 is for two separate boiler feed waters which required monitoring, and it was decided that one sample of each water tested every 15 min would be adequate. This would reduce the quantity of the somewhat expensive TTC reagent required and also would provide ample time to concentrate the sample by boiling. In addition, the test is made more delicate.

Any number of different samples can be catered for with one apparatus and the samples dealt with in rotation in any order by extending the arrangement.

The physical size of available apparatus as well a other considerations roughly establish the quantities of sample to start with and the amount of reagents to be added. The method of automatic control of the amount of each sample used is shown in detail in Fig. 2.

Thus it was found that 100 ml of each sample could be concentrated down to 40–45 ml in the 7½ min cycle without danger of boiling over.

It is obvious that to make the most use of the precipitate an inspection cell should be made to hold about 35 ml, allowing a slight margin to ensure filling the cell.

The cell used was made by clamping two plane electric torch glasses 2½ in dia between two square pieces of ⅛ in brass plate having 2 in holes in the centre of each and using a 15 mm wide ring cut from a 2 in dia steel tube as the "distance piece". Rubber gaskets cut from 1/32 in rubber sheet were used to make the cell water-tight. ¾ in lengths of ¼-in o.d. copper tube, soldered into the ring at the appropriate places, provided the inlet and outlet.

The two feed waters and three reagents (viz. HCl, NaOH and TTC) are each fed to their respective pipettes by rubber tubing. The rate of feed is suppressed in the case of the reagents to about one drop per second, and in the case of the feed water to 100 ml per 5 min.

A glass T-piece is fitted between the drip feed and the pipette. Rubber tubing is run from the T to the boiling funnel via a valve.

Many valves were tried—in mild steel, silver steel and in perspex—but none stood the test of time without developing serious leaks.

The method finally adopted was to use a pinch-cock on the rubber tube made in the form of a spring-loaded blunt chisel, the latter being pulled off by an electromagnet as required.

The timing of these operations is governed by a bank of nine cams mounted on a common shaft and driven by a synchronous motor which rotates the cams one revolution in 15 min. —the time cycle decided upon for the purpose of the particular tests involved. Details of the cam mechanism are given in Fig. 3.

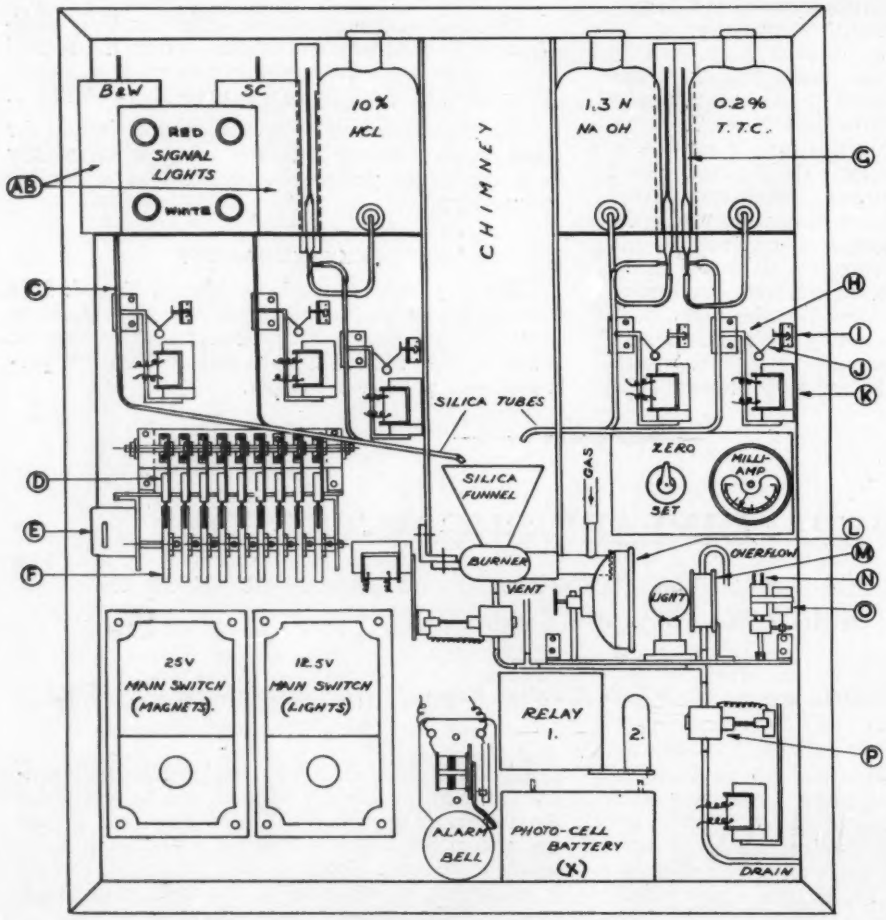

Fig. 1.

A, B—Pipettes measuring known volume of samples alternately.
C—Soft rubber tubes.
D—Micro-switch.
E—Synchro-motor.
F—Cams.
G—Capillary tubes (5 ml).
H—Clamp valve.
I—Adjusting screw.
J—Spring.
K—"Londex" electromagnets.
L—Concave mirrors.
M—Test cell.
N—Heat filters.
O—Photo-electric transistor.
P—Piston valve (steel).
(X) or preferably Power Pack (see Fig. 6).

The sequence is as follows:—

Time (min)	Cam	Switch	Opens Valve	Function
0	1	1	1	Admits 100 ml of boiler "A" feed water to boiling funnel.
1	3A	3	3	Admits 5 ml of HCl and inverts sucrose.
5	4A	4	4	Admits 5 ml of NaOH; brings pH to about 11·0.
6	5A	5	5	Admits 5 ml of TPTZ; forms mauve-red precipitate.
6½	6A	6	6	Opens valve below inspection cell and drains same.
7	7A	7	7	Empties boiling concentrate from funnel to inspection cell.
7½	8	8A	—	Changes signal lights from boiler "B" to Boiler "A"
	9	8A	—	Rings alarm bell.
	End of half cycle			
7½	2	2	2	Admits 100 ml of boiler "B" to funnel.
8½	3B	3	3	Admits 5 ml of HCl and inverts sugar.
12½	4B	4	4	Admits 5 ml of NaOH . . . . *et seq.*

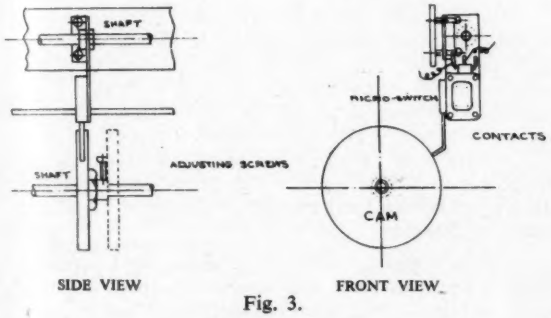

Fig. 3.

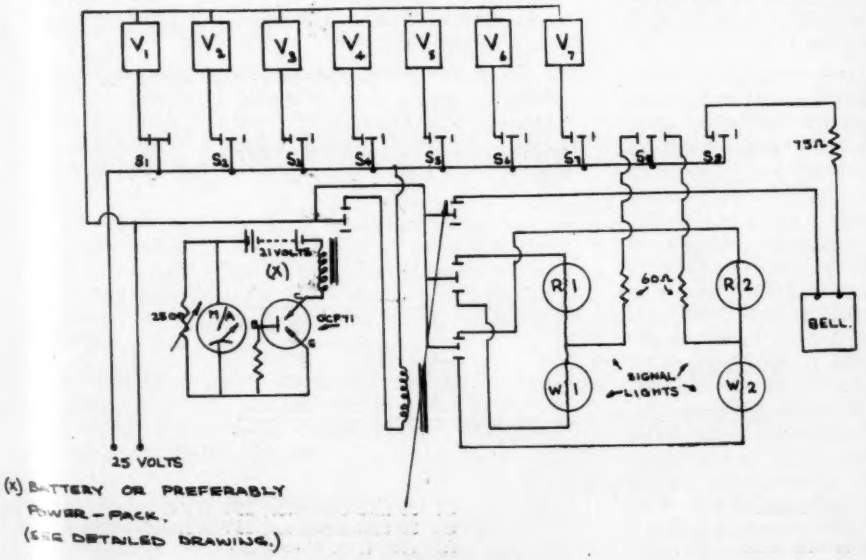

Fig. 4. Wiring Diagram.

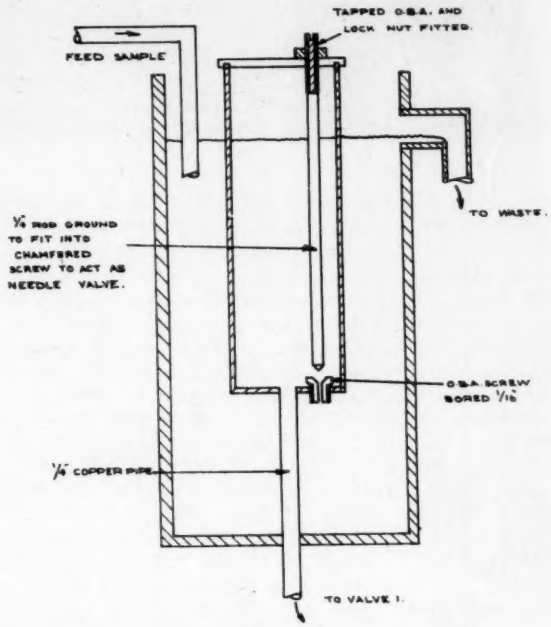
TAPPED B.S.A. AND LOCK NUT FITTED.
FEED SAMPLE
TO WASTE.
¼ ROD GROUND TO FIT INTO CHAMFERED SCREW TO ACT AS NEEDLE VALVE.
B.S.A. SCREW BORED 1/16
¼" COPPER PIPE
TO VALVE 1.

Fig. 2.

Method of drip feed to pipette via a needle-valve. The sample is continuous and the volume constant. Its temperature is maintained by the surrounding water.

Cams 3, 4, 5, 6 and 7 are fitted with two diametrically opposed operating buttons; e.g. 3B closes switch 3 exactly 7½ min after 3A had closed it.

On the other hand, cams 1 and 2 have but one button each, these being set 180° apart.

The "button" of cam 8 is a strip of perspex ⅛-inch thick, and the width of the cam face superimposed for 180°. In this case the switch is of the change-over type, contacting 8*a* to boiler "A" indicating lamps and 8*b* to boiler "B" lamps.

It will be noted from Fig. 1 that each boiler has a pair of signal lights, one red and one white. If the sample under test is clear, the white lamp is illuminated. The presence of sugar illuminates the red (warning) light. As just stated, discrimination between boilers is made by cam 8, whilst that between colours (entrainment or clear) is made by two relays in series. Cam 9 is used to give an intermittent bell alarm in conjunction with the red light.

The motor is operated direct from 50-cycle mains, whilst the valves take their current from a 25-volt transformer. A separate transformer, bridged for 12·5 volts, is used to supply the exciting lamp—12-volt, 12-watt. This step was taken to avoid voltage drop whilst the valves were in use.

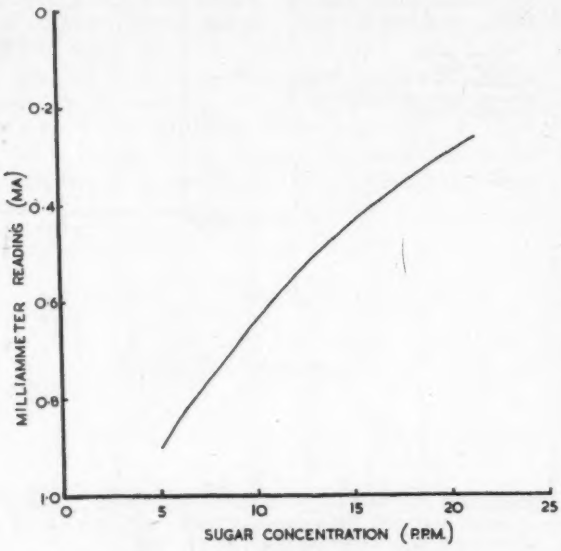

Fig. 5.
Relationship between Sugar Contamination and Current.

The light is focused by a concave mirror through the inspection cell then via two Calorex glass filters on to a germanium photo-transistor which is housed in a small length of $\frac{3}{4}$ in brass tube closed at the top and having a $\frac{3}{8}$ in dia. aperture at the front. The transistor is set in a thin slice of cork which is gently pushed into the end of the tube.

A connecting block is mounted immediately underneath, to which the three gold-plated wires from the transistor are connected. Care must be taken not to bend these leads for $\frac{1}{4}$ in after emergence from the transistor or a fracture may occur.

The three wires in question are connected to (*a*) the emitter, (*b*) the base, (*c*) the collector, which are the functional equivalents of cathode, grid and anode, in that order, of a normal thermionic valve; but, insofar as connexions are concerned, they are the opposite. The emitter is connected to the positive lead and the collector to the negative. The base can be connected to the emitter, but it is rather better to give it a little bias by connecting the base to the emitter via a 47,000 ohm resistor.

In addition to the signal light indicator, a meter has been inserted into the negative lead to the transistor.

With a 10,000 ohm relay in series with the transistor, meter and battery giving 21 volts, the current consumed is about 1·8 milliamps at full illumination, and about 0·3 m/a in the dark. By adjustment of the mechanical zero of the meter, this "dark-current" (0·3 m/a) can be backed off and the meter will read zero. The meter has a full-scale deflection of 1·0 m/a and therefore a variable shunt is used to by-pass 0·8 of the 1·8 m/a taken at full light. Wiring is detailed in Fig. 4.

It can be seen, therefore, that the meter scale will be used over its entire length for a measurement of light intensity. The meter is then calibrated in the usual manner with standard sugar solutions containing 5, 10 and 20 p.p.m. By using three Calorex glass filters, the alarm will ring at 5 p.p.m. or less. Two filters only raise the range of the alarm signal above the 5 p.p.m. level. The actual sensitivity of the apparatus as read on the milliameter is of the order of 2 p.p.m. only.

Various types of boiling funnels were tried—copper, stainless steel and enamelled iron—and all gave reactions with the reagents and were quite useless. Pyrex glass is very chancy—the flame has to be kept very low. The only satisfactory material was Vitreosil.

Using the latter, various substances were introduced to see if their presence interfered with the reaction. Thus glutamic acid, sodium azide, ammonia, copper at 5 p.p.m., sodium sulphate, sodium sulphite and sodium nitrite gave no reaction. The strength

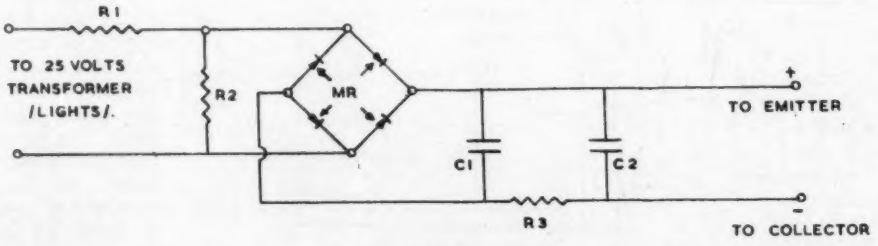

Fig. 6.

Key : R1 21 Ω 5W WW resistor.
R2 75 Ω 5W WW resistor.
MR 4X metal rectifier 16K1 Westinghouse.
C1 50 mfd capacitor, 25V WKG
C2 50 mfd capacitor, 25V WKG
R3 1000 Ω 0·5W resistor.

Overtime Crushing. J. H. O'NEILL. *Proc. 24th Conf. Queensland Soc. Sugar Cane Tech.*, 1957, 17–27.—Overtime cane crushing is discussed in detail, using data from Plane Creek Central Mill Co. Ltd. While no actual costs are mentioned, the author mentions the factors affecting the economics of such a procedure. By means of an example he shows that the factory can sometimes benefit by overtime crushing, all factors being considered, provided that the whole crop would be harvested during the season.

* * *

Compression Ratio and Performance of the Experimental Sugar Mill. K. J. BULLOCK. *Proc. 24th Conf. Queensland Soc. Sugar Cane Tech.*, 1957, 43–62.—Experiments with a two-roll mill were carried out, three to determine the effect of work opening on mill performance, the fourth to analyse juice extraction as a function of roll speed at high compression ratios. The results are tabulated and illustrated with graphs. Cane feed was in 9×18 in pre-compressed blocks for the first three experiments and under pressure chute conditions for the fourth. A steep rise in extraction at low compression ratios of 1·5–2·5 was noted, with a gradual increase from 2·5 to 4·5. Above 40,000 lb the roll load appeared to become independent of feed depth, possibly explained by forward squirting. For three feed thicknesses from 2·5 to 2·9 inches the respective roll loads per lb of cane were 4·16, 4·22 and $4{\cdot}45 \times 10^3$lb, possibly indicating that it is more economical to crush at smaller feed depths. Approximately the same percentage increase was noted for roll torque per lb feed. The increase in roll load and torque is a linear function of the compression ratio from 1·57 to 4·5, values equivalent to those used in practice. There was little improvement in extraction at compression ratios higher than 3, at which it would be 61% at a crushing speed of 40 f.p.m. At low roll speeds (6–30 f.p.m.) graphs of extraction and roll load *vs.* speed indicate a possible relationship between extraction and roll load, the roll load decreasing with speed increase to 30 f.p.m. and then constant from 30 to 75 f.p.m. There was no evidence of slip and only a brief drop of 10% in the load during two out of twelve tests. Work opening was found to have very much more effect on milling efficiency than whether the cane was fibrated or as whole sticks. Combinations of varying preparation, speed and work opening showed that juice extraction is slightly better than theoretical at low speed with fibrated cane, but decreases with increasing speed and does not equal the theoretical as the compression ratio increases. The compression ratio response to roll load at 10 f.p.m. is only half that at 75 f.p.m. The roll load for whole sticks decreases from 10 to 42 f.p.m. and is then fairly constant, this being opposite to the effect with fibrated cane and speed increase. Roll load is uneconomically used above a compression ratio of 3·5.

* * *

Dynamic Bagasse Compression Tests. C. R. MURRY. *Proc. 24th Conf. Queensland Soc. Sugar Cane Tech.*, 1957, 63–79.—Tests were carried out using a hydraulic press fitted with a servo-control whereby the ram position corresponded to the position of a follower running either on a "linear" cam (giving the ram constant velocity) or a "mill" cam, giving the ram a velocity similar to the rate of compression in a mill. Results show that the work per lb of cane increases with increasing coarseness of preparation, although not in the proportion noted with static tests. Velocity of juice flow is a most important factor in the work required, and it is easier to force the juice through the mat at right angles to the direction of compression, which casts doubt on the usefulness of juice grooves. Under "no slip" conditions juice grooves of the proportions used are of little benefit as they reduce extraction as well as work required. Under "no slip" conditions higher compression ratios give higher extractions, but the work required increases rapidly with increased com-

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of the solutions used is as follows:—

Acid—100 ml of A.R. HCl per litre.
Alkali—80 g of commercial NaOH per litre.
TTC—1 g triphenyl tetrazolium chloride per litre.

The relationship between the current registered on the milliameter is not quite linear, as will be seen from the graph (Fig. 5), but is sufficiently near to allow for a scale to be fitted giving direct readings in p.p.m. of sugar. A recorder could be fitted if required.

Details of a power pack recommended for use instead of dry batteries for operating the photo-cell and which maintains a stable supply continuously are given in Fig. 6.

ACKNOWLEDGMENTS

The authors wish to express their thanks to the Directors of British Sugar Corporation Ltd. for permission to publish this work.

pression ratio. Most work at normal compression ratios when working fine cane is due to the forcing of the juice through the mat of fibres. For good estimation of power requirements using the press, the rate of compression and the velocity of juice relative to the bagasse are highly important. In the mill the relative velocity of the juice to bagasse is greater than in the press (about 2·1).

* * *

Improving Extraction at a No. 1 Mill. W. R. CRAWFORD. *Proc. 24th Conf. Queensland Soc. Sugar Cane Tech.*, 1957, 89–103.—Theoretical considerations of first mill performance are discussed, the importance of re-absorption in limiting extraction of three-roller mills being emphasized. Extraction tests carried out with a previously described experimental mill[1], the top roller of which was fixed, showed that increase of roller speed while maintaining a constant feed volume per minute increases the crushing rate, which is accompanied by increased compression ratio and increased feed roller extraction, this last increase being greater than the additional loss at the delivery roller due to re-absorption. However, ultimate extraction apparently approaches constancy at certain high speeds. Increasing the mill ratio to more than 2 by reducing the delivery opening is accompanied by an appreciable increase in feed roller extraction, e.g. at a crushing rate of 1·6 cu. ft. cane per minute, juice extraction at a ratio of 3·035 was more than double that at a ratio of 2. Such behaviour is possibly explained by the development of high pressure over the turn plate, caused by slip at the delivery roller, accompanied by reduced feeding ability of the mill. Re-absorption, which commences at apparent compression ratios of 2–2·2, when extraction is 59–63%, is inevitable at higher extractions with existing three-roller No. 1 mills. Extraction of juice from shredded cane was significantly greater than from coarsely prepared cane, the pol extractions showing the same trend. In a comparison of the Queensland No. 1 mill performance with that of the Frome factory No. 1 mill, it is suggested that the more efficient performance of the latter is due to the effect of the large roller grooving and the transverse feeding grooves on the mill feeding ability, and to the fact that the top roll floated at a load of 47·4 tons/ft. Low roller speed is considered not to effect good extraction. The gripping angle of the Frome mill is discussed. A feed compression ratio of 1·3–1·5 with an appropriate mill ratio which will give an overall ratio of about 3 and thus a juice extraction of about 70% is recommended.

* * *

Power Requirements of the Three-Roll Experimental Mill. D. S. SHANN. *Proc. 24th Conf. Queensland Soc. Sugar Cane Tech.*, 1957, 105–113.—Power consumption under various conditions of operation are discussed. Additional extraction with increased mill ratio is only achieved by rapidly increasing the power input, extractions above 70% demanding a great amount of power. Increase in roll peripheral speed (while maintaining constant escribed volume) to allow higher ultimate crushing rates and compression ratios, thereby increasing extraction, results in a definite increase in power/ton of cane, the increase in unit power consumption at the ultimate rates being >40% for an increase of 16% in rate and a rise of 3 units in extraction. The power consumption was far greater for coarse commercial cane preparation than for fine shredding, the power thus saved greatly contributing to the power supply of the Searby shredder used for the fine preparation. Other advantages in the use of the shredder are reduced roll pressures and journal loads. For a given extraction, power consumption per unit of cane is greater in a mill with small diameter rolls than in a large-roll mill. The power consumption of turnplates is also discussed.

* * *

Some Considerations in the Use of Turbine Drives. H. E. B. SCRIVEN. *Proc. 24th Conf. Queensland Soc. Sugar Cane Tech.*, 1957, 165–170.—The use of a steam turbine drive is discussed with respect to possibilities of overloading, tooth pressures, and stresses. The need for caution is emphasized in view of the tendency towards uneven feeding in Queensland, which can lead to abnormal loads and so excessive wear. Power and consumption curves are given for a 600 h.p. turbine at certain speeds.

* * *

The Care and Maintenance of Conveyor Belts. B. C. KEOGH. *Proc. 24th Conf. Queensland Soc. Sugar Cane Tech.*, 1957, 171–178.—Included are discussions on conveyor inspection and lubrication; belt, idler and pulley cleaning, and on loading points. The advantages and disadvantages of certain belt cleaning devices are given, the most effective being the rotary beater and the rotary brush. Recommendations are made for loading material on to the belt, and emphasis is laid on the need for careful selection of the correct type of belt for use in the factory.

* * *

Automatic Hardsurfacing as applied to Sugar Mill Maintenance. D. C. COOKE. *Proc. 24th Conf. Queensland Soc. Sugar Cane Tech.*, 1957, 179–190.—The advantages of automatic and semi-automatic "hidden", or submerged, arc welding to the sugar factory are discussed, together with the metallurgy and procedures of hardfacing. The relative costs of automatic and manual welding are tabulated, and installation of semi-automatic equipment for hardfacing and general maintenance in the factory is recommended.

* * *

Centralized Lubricating Systems as applied to Sugar and Heavy-Duty Industrial Plant. C. G. WYATT. *Proc. 24th Conf., Queensland Soc. Sugar Cane Tech.*, 1957, 191–200.—Methods of lubricating factory plant are listed and lubrication pumps and systems are discussed. The operating characteristics of the series (progressive) and parallel (or header) types of centralized lubricating systems are compared.

[1] *I.S.J.*, 1957, **59**, 283.

New Books and Bulletins

The Gilmore Hawaii Sugar Manual 1957. Ed. F. I. MEYERS. 144 pp; $7\frac{3}{4} \times 10\frac{1}{2}$ in. (Gilmore Publishing Co. Inc., 525 Audubon Building, New Orleans 16, La., U.S.A.). 1957. Price: $10.00.

The Gilmore manuals have achieved a unique position in being a recognized authentic record of the industry and individual factories of the areas covered. The latest Hawaii manual is no exception, and once again provides the complete and accurate picture which has come to be expected. The first section, for the Islands as a whole, lists the active plantations, agencies, and plantation personnel, also giving statistics of production, details of the H.S.P.A etc., and also giving an illustrated account of the C. & H. plants at Crockett, California, and Aiea, T.H.

There follows the customary detailed description of the organization, agricultural, general and factory information on each operating factory, which includes a résumé of manufacturing results for the 1955 and 1956 seasons. For anyone requiring information on the Hawaiian industry, this must be the first choice.

* * *

Reports on the Progress of Applied Chemistry, Vol. XLI. 795 pp; $5\frac{1}{4} \times 8\frac{1}{4}$ in. (Society of Chemical Industry, 14 Belgrave Square, London, S.W.1). 1957. Price: £5 0s 0d.

The gamut of industrial chemistry is covered once more in the latest of the "Applied Reports" which reviews the published literature of 1956. Fuel and fuel products; inorganic chemistry, metals; organic chemistry; biological products; textiles, plastics, adhesives and paints; chemical engineering and hazards; and agriculture and food are the main classifications—and in the section "Food" of the last appears the review on Sugars, by Dr. A. CARRUTHERS. This has a total of 56 references to the literature and deals with general sugar topics, factory operations, by-products, ion exchange, analysis, sucrochemistry and stereo-chemistry.

* * *

Mechanical Catalog, 1958. 714 pp; $8 \times 11\frac{1}{4}$ in. (The American Society of Mechanical Engineers, 29 West 39th Street, New York, N.Y., U.S.A.). 1957.

This, the 47th annual edition of the catalogue, is divided into four sections, the first of which is a recruitment guide to companies seeking engineers and technical and scientific personnel. The second is the Product Data section in which leading U.S. manufacturers supply latest technical information and specification data on their indexed products. The third section gives all available material on A.S.M.E. codes, standards, periodicals and other publications; while the fourth section is a very comprehensive directory containing over 40,000 listings of 6000 products and 3500 manufacturers. Cross indexing with the catalogue section enables the reader to locate specific product information.

* * *

Proceedings of the 25th Annual Convention of the Sugar Technologists' Association of India, 1957, Parts I and II. 194 + 332 pp; $7\frac{1}{4} \times 9\frac{3}{4}$ in. (Sugar Technologists' Association of India, Nawabganj, Kanpur, India). 1957.

Both parts of the 1957 Proceedings of the Association include a brief description of the Association and its functions, together with the officers elected for 1956/57, staff, past-presidents, patrons and honorary fellows. The text of the papers read to the convention follow, numbering 41 in all.

* * *

1957 Report, Experiment Station Committee, Hawaiian Sugar Planters' Association. 80 pp; $7\frac{3}{4} \times 10\frac{1}{2}$ in.

The activities of the Experiment Station during October 1956 to September 1957 are recorded in this report, which covers cultural practices, diseases, factory technology, geophysics, insects, irrigation, mechanization, organic chemistry, varieties, and weed control, as well as personnel training and experiment station staff and personnel changes.

* * *

Proceedings of the 14th Annual Convention of the Deccan Sugar Technologists' Association (India), 1957. Part I. 197 pp; $6\frac{1}{4} \times 9\frac{3}{4}$ in. (Deccan Sugar Technologists' Association (India), P.O. Sakarwadi, Dist. Ahmednagar, Bombay, India). 1957.

A table of contents is followed by names of office-bearers of the Association for 1956/57, council members and co-opted members, the technical sub-committee, prize plot committee, honorary members, patrons, life members, and companion members. The silver jubilee of Padegaon sugar cane experiment station is commemorated in an article by M. Y. KARVE, and the texts then follow of the 30 papers read at the Convention. An appendix lists the rules, and conditions of the prize plot competition and a table records field and factory performance data from sugar companies of the region.

Laboratory Methods and Chemical Reports

Cataphoretic Studies on the Structure of Cane Juice Colloids and its Relation to Juice Coloration. D. N. GHOSH. *Indian Sugar*, 1957, **6**, 685–690.—During electrophoresis, the juice in the anode part of the U-tube separated into a greenish and a semi-turbid brownish layer, while that in the cathode tube became yellowish in the electrode region and deepened to violet and finally to black on prolonged exposure. The reddish-brown layer showed a pH of 4, and that from the cathode pH 9. The original green colour of the juice returned on mixing, when the pH was then 5. With a pair of sheathed platinum electrodes in a column, the anode at the top, the greenish layer receded towards the bottom, lowering of the electrodes making this into a concentrated mass at the bottom, while the brownish layer (semi-turbid) stayed at the top. Development of the acidity in the electrode region of the anode limb is mainly attributed to the accumulation of pectic acid anions generated from pectin bodies in the raw juice, although the sudden acidity development in the brown layer and of high alkalinity in the greenish layer beneath it is due, it is suggested, to the presence of an alkaline constituent which moves with the receding boundary layer during electrophoresis. The greenish layer proved to be non-nitrogenous and is associated with the anthocyanins. Thus the composition of the colloidal electrolyte and the electrolytic dissociation may be represented:—

$$\underset{\text{pectinic acid}}{P^- H^+} + \underset{\text{anthocyanine}}{B^+ OH^-} = P^- B^+ = P^- + B^+$$

The brown colour is due to the alkalinity on liming of the juice, when the ring structures are ruptured, the pectinic acid ring giving arabinose and other decomposition products, while the anthocyanidine ring gives phloroglucinol and its derivatives, the interaction of the products giving the brown colour.

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Physico-Chemical Study of Beet Juice Purification. (IV) Determination of the Electrokinetic ζ Potential of the $CaCO_3$ Particles produced on the Saturation of Sugar-Lime Solutions with Carbon Dioxide. J. VASÁTKO and R. KOHN. *Listy Cukr.*, 1957, **73**, 91–95.—Details are given of the capillary diaphragm used in the experiments in which a 15% sugar solution was treated with lime (1·50 g CaO/100 ml solution) and saturated with CO_2 at 85°C for 12 min. The ζ-potential was determined at 20°C in $CaCO_3$ particles suspended in juice strongly undercarbonatated (pH 11·7), carbonatated, and solutions over-carbonatated to the point of saturation of $Ca(HCO_3)_2$ (pH 7·2). The results are tabulated and shown graphically. The dependence of the electrokinetic potential on the degree of carbonatation of the sugar-lime solution is illustrated. A positive potential was found over the whole range of alkalinity. In under-carbonatated solutions containing 0·002–0·003 *N* $Ca(OH)_2$ the potential reached a maximum of $\zeta = +18{\cdot}6$ mV, while over-carbonatated solutions showed the highest potential ($\zeta = +20$ mV).

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The Filtration Test for Sugars. R. T. BALCH. *Ind. Eng. Chem.*, 1957, **49**, 904–906.—It had been found that the presence of 0·025% of $CaCl_2$ in distilled water reduced the time necessary to filter a given quantity of kieselguhr suspension by almost 43%, other conditions being equal. The effect of salts on sugar filtrability with kieselguhr was studied at 20 lb/sq. in. cloth pressure at 85°C, the rate of filtration being expressed as the volume collected in 30 min, using a 1% suspension of kieselguhr in a 60% solution of refined sugar, to which salts were added. An increase in filtrability was found with various chlorides, the effect increasing with valency of the cation. The addition of $CaCl_2$ to raw sugar solutions increased the filtrability, but by comparatively smaller amounts because of the naturally occurring salts present. An anomaly was found in that the effect of $CaCl_2$ on the filtrability of washed raw sugar was smaller than expected. The effect of pH on the filtration rate of raw sugar is also discussed and data tabulated. Very small amounts of salts were sufficient to alter the rate of refined sugar appreciably, and this raises doubts as to the value of the filtrability test as a criterion. The use of two filtration tests for raw sugar is suggested, one at the normal pH, the other after adjustment of the solution with NaOH or lime to a set alkalinity, e.g. pH 7·5 or 8·0. The resulting change in filtrability might be a guide to subsequent refining quality.

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Department of Sugar Chemistry and Technology and Sugar Research Scheme. *I.C.T.A., Trinidad, Report*, 1956, 48–51.—Study of raw cane juice showed it to be a dilute suspension, all particles having proteinaceous and possibly polysaccharide material adsorbed at their surface. Precipitation, flocculation and settling characteristics of pure calcium and magnesium phosphate precipitates were studied and the results compared with those obtained using raw juice samples. Filter mud wax was found to contain 0·02–0·17% N. Paper chromatography of hydrolysates revealed a choline and serine content, indicating presence of phospholipids. The principal phenol in

cane leaves is ferulic acid, others identified including *p*-coumaric acid, sinapic and caffeic acids. The red pigment in B 37161 was shown to be cyanidin. In studies on cane deterioration during open storage, it was noted that as the cane became stale the amino-acids/Bx ratio of the juices greatly increased, and that, although apparent purity of juice from fresh cane was slightly greater initially than gravity purity, at the end of the test it was less. The B 47 cane varieties had much greater mud volumes than the standard B 37161 (about 20% increase). EDTA is more effective in dissolving calcium sulphate than HCl; regenerated solutions are less efficient than fresh EDTA solutions, but are still satisfactory. Sodium citrate, cheaper than EDTA, dissolves calcium sulphate as efficiently as EDTA, though it is effective with only certain types of scale. Extraction of filter-cake with alcohol, after water-washing to remove sugars and other water-solubles, gives a resin-free material which can be hydrolysed by alkali to give ceryl alcohol, sigmasterol, sitosterol, and fatty acids, the total sterol content of dry Hawaiian filter-cake used being 0·3%. The formation of N-compounds in the ammonia and glucose-fructose reaction at 140°C, has been studied. Pilot plant production of levulinic acid was found to be uneconomic because of the high HCl consumption and low levulinic acid yield with further loss during recovery. Levulinic acid in the presence of HCl, formic acid and other reaction products, was estimated initially by paper chromatography, a polarographic method subsequently being adopted for routine analyses.

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Crystallization in Low-Purity Syrups. D. H. FOSTER, G. H. DAVIES and B. D. SOCKHILL. *Proc. 24th Conf. Queensland Soc. Sugar Cane Tech.*, 1957, 223–231.—Crystallization experiments carried out on Racecourse and Mourilyan molasses at different purities and degrees of supersaturation are discussed. Icing sugar seed was added to the molasses kept in a constant-temperature bath. The larger crystals were removed from samples taken at intervals, and the saturation temperature of the mother-liquor determined. Corrections for the increasing crystal area were based on a calculated value for the increase in weight of the crystals for a given drop in supersaturation. The first order rate constant k of Van Hook's equation, $\frac{ds}{dt} = k\ (S_t - S\infty)$, where S_t = supersaturation at time t, and $S\infty$ = saturation at equilibrium, was calculated from the slope of the curve according to the equation $\log (x_{t+\Delta} - x_t) = -kt + const.$, where x_t is the drop in saturation from zero to time t and $\Delta = 5$ min. The values of k are tabulated together with the molasses purity and the initial supersaturation values. The results conform to a first order process. A rise of four units in purity causes only a small increase in the crystallization rate for Mourilyan molasses, while having greater effect on Racecourse molasses which, in general, crystallized slightly more rapidly than the former despite its higher ash content and higher viscosity. Little correlation was shown between molasses viscosity and crystallization rate, in accordance with results obtained by VAN HOOK[1] using solutions at higher purity. The materials contributing largely to the high viscosity of the molasses, limiting sugar recovery, are discussed, especially polysaccharides and peptides. A polysaccharide material separated from Pleystowe molasses by repeated precipitation from 80% alcohol and treated with cation exchange resin, which reduced its ash content to 1·6%, contained 26% pentosan, and on hydrolysis gave only glucose and xylose on qualitative analysis by paper chromatography. 1·1% N was present. The molasses contained at least 1·4% of this material. Addition of 2–3% of the polysaccharide approximately doubled the viscosity of molasses and of a synthetic glucose–fructose solution saturated with sucrose. The crystallization rate of pure sucrose solution was twice that of this synthetic solution, while aspartic acid and the carbohydrate material retarded crystallization. While fructose and glucose retard sucrose crystallization, aspartic acid may almost stop it once a certain degree of supersaturation is reached. The pH of the solutions containing aspartic acid and polysaccharides was 3·0–3·6, but in molasses of pH 5·0–6·0 these would be present as salts and would probably not have the same effect on crystallization of sucrose. Tyrosine was shown not to affect crystallization.

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Effect of Ammonia in Reducing Lime Salts Content of Beet Juices and "Artificial Juices". R. CAROLAN. *Irish Sugar Co. Ltd. Res. Lab. Rept.*, 1956, **36,** 6 pp.; through *S.I.A.*, 1957, **19,** Abs. 325.—Previous experiments were extended by tests with first carbonatation juice and with "artificial juice" (15°Bx sugar solution with addition of partly neutralized glutamic acid), with and without addition of ammonia, these juices being submitted to second carbonatation taken to varying pH values within the usual ranges. The improvements in effective alkalinity of the thin juices on addition of ammonia showed fair correspondence with the increase in total nitrogen, but not with the optimum lime salts contents subsequently attained. The lime salts in thin juice were improved by ammonia addition from about 5 m.equiv./100°Bx to about 2 m.equiv., the figures varying little between pH 8 and 9. Results with artificial juice were similar, with a little more reduction in lime salts. Estimates of carbonate and bicarbonate contents of the second saturation juice showed puzzling inconsistencies; possible sources of error are discussed. It would thus appear desirable to reduce lime salts by retaining as much ammonia in the juice as possible (by use of as low temperatures as possible in defecation and first carbonatation) or to add ammonia (e.g. by using ammoniacal condensate for filter press washing) up to second saturation stage; the ammonia is, however, undesirable during evaporation, and would be best removed by preliminary boiling under vacuum ; soda, though melassigenic, might then be added to give the desired thick juice alkalinity.

[1] *I.S.J.*, 1944, **46,** 134.

Comparison of Some Methods of Invert Sugar Determination in the Presence of Sucrose. L. ROZENTAL. *Roczniki Panstwowego Zakladu Higieny*, 1956, **7**, 521–530; through *S.I.A.*, 1957, **19**, Abs. 354.—Comparative tests of the Lane-Eynon, Luff-Schoorl, Bruhns, Bertrand and Fellenberg & Demont methods have shown that the Lane-Eynon method is best; the Luff-Schoorl method is sufficiently accurate when the sucrose content is <99%; the Bruhns method is suitable only for rough determinations; the last two methods were unsatisfactory.

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Application of Lactate instead of Tartrate in Copper Reagent for the Determination of Sugars by the Reduction Method. E. PIJANOWSKI and M. ZEBROWSKA. *Przemysl Spozywczy*, 1956, **9**, 282–284; through *S.I.A.*, 1957, **19**, Abs. 355.—Satisfactory results could be obtained when using sodium lactate instead of tartrate in the Bertrand reagent. The amounts required were either 127·6 g of commercial "edible" grade lactic acid (49·9% purity) with 207 g of NaOH per litre, or 204 g of "pure" (86·8%) lactic acid with 241 g of NaOH per litre. When using "pure" acid, more was needed, and some sodium alum was added before the NaOH to prevent precipitation of a brown deposit. When using the commercial acid, the solution had a foxy smell and a gummy precipitate was formed; owing to the presence of some reducing sugars, small amounts of Cu_2O were also precipitated, but this ceased after storage at room temperature for ten days, or at 40°C for five days; the precipitate was easily removed by filtration.

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A New Spray for Spotting of Sugars on Paper Chromatograms. E. BORENFREUND and Z. DISCHE. *Arch. Biochem. Biophys.*, 1957, **67**, 239–240; through *S.I.A.*, 1957, **19**, Abs. 357.—Dried chromatograms are sprayed with a freshly-prepared reagent consisting of 25 ml of glacial acetic acid, 1 ml of HCl, and 2·5 ml of 5% phloroglucinol solution. The chromatograms are then dried at room temperature and heated for 2 min at 90°C. Aldopentoses are shown as purple spots, ketopentoses dark green, ketohexoses yellow-brown, methylpentoses yellow, heptuloses green, dihydroxyacetone a pale greenish-yellow, glyceraldehyde and aldotetrose violet, and ketotetrose reddish-brown. Further differentiation is possible by examination of the sprayed chromatograms under an ultra-violet lamp fitted with a blue filter, when erythrose spots have a strong blue fluorescence, erythrulose shows red-violet, dihydroxyacetone becomes violet, and glycolic aldehyde and uronic acids are violet and are seen only with ultraviolet light. The colour of aldohexose spots does not change. The colours are stable for several days.

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Separation of Sugars on Carbon Columns by Gradient Elution. M. A. JERMYN. *Austral. J. Chem.*, 1957, **10**, 55–78; through *S.I.A.*, 1957, **19**, Abs. 358.—With reference to possibilities of gradient elution, measurements are reported of the desorption of sugars from a carbon ("Darco G–60")—cellulose column by various organic solvents. The order of the affinities of the charcoal for sugars (lactose>cellobiose>sucrose>raffinose) is not the same as that of the tenacity with which they are held when once adsorbed (raffinose>cellobiose>lactose>sucrose). There is competition between the sugar and the desorbent for a limited amount of charcoal. The theory of these effects is discussed in detail, including the effect of concentration gradient on desorption, and the conditions when several substances are adsorbed. Several experiments on the separation of the oligosaccharides from cellulose hydrolysis are reported.

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Sucrose Inversion in the Presence of Ion Exchange Resins. M. A. PINDAT. *Sucr. Franc.*, 1957, **98**, 176–180, 215–218, 241–245, 272–280.—Ion exchange and sucrose hydrolysis are reviewed and tests described on sucrose hydrolysis in HCl of various strengths; using cation exchange resins in both H and K forms; and with a combination of the cation exchanger in K form plus acid. Tables and graphs of the data resulting from the first series show inversion to be relatively slight above pH 1·75 and very slow at pH 4·1 at 20°C, while at this pH at 35°C the reaction was six times as fast. At the lowest pH (0·25) the % sugar of the original content decomposed in 75 min was 26·9, at pH 4·1 it was only 0·03 after 24 hr. A solution of 208 g/litre sucrose was passed through "Permutit 50" cation exchange resin in its H form at 20°C. The initial pol of 76 was reduced to 63·6 after $6\frac{1}{2}$ hr, when the % reducing sugar content (determined by the method of SAILLARD[1]) was 2·8 grams/100 c.c. The pol decreased by 1° per 0·99% sugar decomposed. At pH 4·1 the reaction was 1·8 times as fast as with HCl. The resin was saturated with potassium and the inversion rate constant found to be the same at pH 6 as when using only acid as catalyst at pH 3·1.

That H^+ ions in the resin are less active than those in HCl is demonstrated by the fact that the inversion rate at pH 0·25 is $51{\cdot}5 \times 10^{-4}$ with HCl, and $3{\cdot}59 \times 10^{-4}$ with the resin. The acid pH value which would produce the same rate as the resin at pH 0·25 is 1·08, calculated from W. ANDERSSON's formula ($pH + 2{\cdot}26 = -\log_{10}K$, K being the inversion rate). Results show that the hydrolysing action of the resin plus regenerating acid is greater than the sum of the separate effects of resin and acid. Increase of temperature and initial sucrose concentration both cause the rate of inversion to increase. Hence, industrially, sugar juice treatment should be at as low a temperature as possible; contact time should be short; and concentrated sugar solutions should not be treated. The treatment of molasses rather than carbonatation juice is recommended as the total amount of sugar in contact with the resin is less.

[1] *Betterave et Sucrerie de Betterave*, 1923, 137.

BY-PRODUCTS

Manufacture of Paper Pulp from Bagasse in Cuba. E. A. VÁZQUEZ. *Mem. XXIX Conf. Asoc. Técn. Azuc. Cuba*, 1955, 283–288.—The economics of paper pulp production are discussed.

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Treatment of Molasses for Production of Alcohol and Yeast. G. T. REICH. *Mem. XXIX Conf. Asoc. Técn. Azuc. Cuba*, 1955, 289–297.—At 180°F, 75–88% of lime in molasses is precipitated by the action of ammonium sulphate at certain pH, temperature and concentration conditions. Alcohol, even at the low concentration in the fermentation vessel, will act as a precipitating agent, and under the correct conditions of pH and temperature only one hour will be required for the reaction. The density is as fundamental in the purification of molasses as the pH.

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Obtaining D-Fructose from Sucrose. D. GARCÍA ROMEU. *Mem. XXIX Conf. Asoc. Técn. Azuc. Cuba*, 1955, 321–325.—An account is given of the preparation of fructose and glucose from sucrose by hydrolysis in acetone solution with sulphonic acid-type cation exchangers, whereupon the glucose is produced and crystallizes in high purity, while the acetone-fructose reaction is catalysed with formation of the di-*iso*propylidene compound which can be separated and converted to crystalline fructose.

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Chemical Derivatives of Sugar in Industrial Use. (Cane By-Products). E. A. VÁZQUEZ. *Mem. XXIX Conf. Asoc. Técn. Azuc. Cuba*, 1955, 327–332.—The use of sugar cane for fodder is discussed.

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Chemical Derivatives of Sugar in Industrial Usage. J. DUBOURG. *Sucrerie Franç.*, 1957, **58**, 47–53.—A general review is made of the numerous sugar derivatives having a wide field of application in industry. The products concerned are those of fermentation, oxidation, hydrogenation and esterification, the last including detergents.

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Significance of Oligosaccharide Intermediates in Dextran Synthesis. R. W. BAILEY, S. A. BARKER, E. J. BOURNE, M. STACEY and O. THEANDER. *Nature*, 1957, **179**, 310.—A recently synthesized trisaccharide, in which a glucopyranosyl group is attached (1→6) to the glucose moiety of a sucrose molecule, has been subjected to the action of dextransucrase alone and in the presence of sucrose. Alone, it is not affected; in the presence of sucrose, both disappear rapidly. Analysis of the products is described, and it is concluded that unbranched dextrans must be built up by successive transfers of single glucose units and that transfers of pre-formed chains are not involved. Thus a dextran molecule formed from either sucrose or the trisaccharide would have a terminal fructose residue. It is likely that a multi-chain mechanism is involved where slow initial synthesis of the trisaccharide is followed by rapid polymerization to dextran.

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The Progress of Sucrochemistry. J. L. HICKSON. *Sugar Molecule*, 1956–7, **10**, (2 & 3), 19–24.—A survey of sugar cane by-products.

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Outline of Sucro-Chemistry. J. DUBOURG. *Ind. alim. agric.*, 1956, **73**, (1), 625–630.—The advantages and disadvantages of sugar as industrial raw material, the products of fermentation and oxidation, hydrogenation of the sugars and the esterification of sugars and formation of detergents are reviewed. The non-sugar constituents of beet (glutamic acid, betaine) and the by-products (molasses and pulp) are also evaluated.

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Utilizing the Valuable Substances contained in Steffen's Filtrate. E. A. MOGIL'NY. *Sakhar. Prom.*, 1957, (2), 48–50.—A general review of betaine, with special mention of its origin, uses, and possible methods of recovery.

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Glutamic Acid Recovery after Desugarization. G. S. BENIN. *Sakhar. Prom.*, 1957, (2), 50–53.—A general review of glutamic acid and monosodium glutamate recovery from the waste from the barium saccharate and Steffen separation processes, with special mention of the recovery of the salt at the Johnstown sugar factory, Colorado, U.S.A.[1]

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The Puerto Rico Rum Industry. T. J. HEFFRON. *Sugar J.* (La.), 1957, **19**, (12), 54–55, 57.—A general review is given of the history and modern development of the industry, which annually contributes more than $25 million to the treasury in taxes. About 4–4½ million gal have been distilled annually during the past few years, consuming about 6 million gal of molasses out of the island's 50–60 million gal per year.

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New Outlets for Sugar in the Non-Food Field. H. B. HASS. *Sugar J.* (La.), 1957, **19**, (12), 66–67, 70.—The advantages of sucrose detergents are discussed, and other possible uses of sugar are mentioned, including those in the surface coating and plastics industries. Tests have shown that sugar subjected to catalytic hydrogenation in the presence of ammonia yields 2-methylpiperazine, which is easily converted to synthetic fibres.

[1] *I.S.J.*, 1956, **58**, 203.

Patents

UNITED STATES

Process for Producing Glutamic Acid. J. L. PURVIS and H. L. FIKE, assrs. INTERNATIONAL MINERALS & CHEMICAL CORP., of New York. **2,796,433.** 27th August 1954; 18th June 1957.—Steffen's filtrate is hydrolysed with alkali [50% aqueous NaOH solution or $Ba(OH)_2$] and the pH adjusted to >7 (9–11) with conc. HCl or CO_2 after heating, e.g. to about 88°C for 2¼–2½ hr. The hydrolysate is concentrated, if necessary, to at least 25% (40%) solids, and treated with a water-soluble barium salt ($BaCl_2$), so precipitating the inorganic impurities. Adjustments of the pH and/or the dry solids content may be made after addition of the barium salt. The filter-cake is not washed, but sodium carbonate added, sufficient to precipitate all the excess barium ions as barium carbonate. The filtrate is adjusted to pH 5 with conc. HCl and concentrated to a viscosity of 375 centipoises at 80°C. After removal of the inorganic salts (KCl. NaCl), which crystallize during concentration, the filtrate pH is adjusted to about 3·2 with conc. HCl and the liquor left at room temperature for five days with occasional agitation to allow crystallization at the isoelectric point, giving a recovery of about 80%. Alternatively, the barium salts filter-cake may be filtered off and washed, the washings then being discarded to reduce the amount of end liquor, or they may be recycled back into the process. The primary filtrate pH is adjusted to about 4·5 with 50% H_2SO_4 solution, concentrated, and the salts (K_2SO_4, Na_2SO_4) crystallized at approximately 80°C. The pH of the resultant filtrate is adjusted to about pH 3·2 with 50% H_2SO_4 solution and the liquor stood at room temperature for five days, giving a glutamic acid recovery of 82%.

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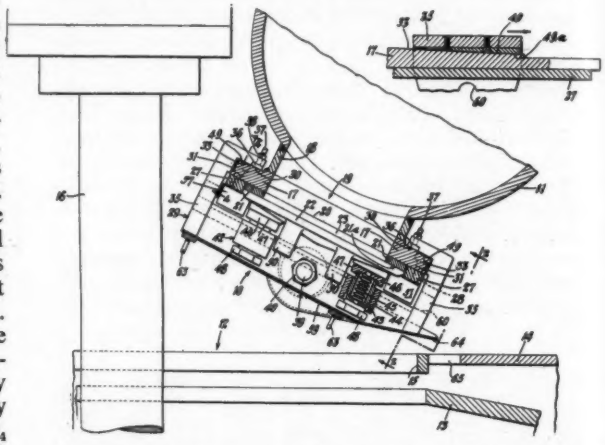
Dextran Isolation. L. J. NOVAK and G. S. STOYCOS, assrs. THE COMMONWEALTH ENGINEERING CO. OF OHIO, of Dayton, Ohio. **2,798,065.** 21st May 1954; 2nd July 1957.—A sufficient amount of a water-miscible aliphatic alcohol or ketone (isopropanol) is added to a dextran fermentation product (15–30% by weight) to make it relatively fluid while precipitating the impurities during a period of ½–1 hour without precipitation of an appreciable amount of the dextran. The crude dextran is precipitated from the filtrate by increasing the concentration of the isopropanol, e.g. to 35–50%. For hydrolysis, the crude dextran is dissolved in water (30% of original fermentation volume) and heated to 75–85°C at a pH of 6·8–7·0, adjusted to pH 1·04–1·26 with conc. HCl or H_2SO_4, heated at 75–85°C for 1 hr, neutralized with NaOH, cooled to 35–40°C, followed by isolation and drying of the required fractions.

Loading Gate for Centrifugals. W. GRIESELHUBER, assr. THE WESTERN STATES MACHINE CO., of Hamilton, Ohio, U.S.A. **2,789,730.** 18th May 1955; 23rd April 1957.—The massecuite charge is delivered into the centrifugal interior 12 from the supply tank 11 through the exit port 19. This has a neck 18 to which is connected the valve body 17. The lower end 20 of this body carries an end-facing 21 of bronze enclosing the port 19. The valve closure 22 seats against this end-facing and slides along back-



wardly-extending rails of the valve body, part of which is formed by the stationary guides 27. The valve actuating mechanism includes a cross-head 29 supported by the upper bearing surfaces 30 of the valve body, which extend virtually the length of the rails mentioned above. The cross-head comprises two end portions 35 connected by a body portion to which is connected the shaft 39 which moves horizontally under hydraulic pressure so as to draw the cross-head 29 along the rails to open and closed positions. The valve closure 22 is kept at the required pressure against the end-facing by springs 43, and the position of the cross-head unit is limited by a system of stops and pawls and by a wedge arrangement between the end-portions 35 and the valve body 17. A drip-catching pan 59 is mounted on the cross-head 29.

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Centrifugal Battery Control System. J. B. BANGE, assr. THE WESTERN STATES MACHINE CO., of Hamilton, Ohio, U.S.A. **2,790,553.** 20th June 1955; 30th April 1957.—A system is described in detail which will permit an overall control to be exercised over a battery of centrifugals so that, by means of actuators

and timers, the power consumption peaks of the machines do not coincide and power consumption of the battery does not become exorbitant. The arrangement is such that, after each machine has been set in motion suitably, the overall control is cancelled and each machine re-cycles automatically until power consumption again becomes too great, when the cycles are completed for each machine but re-cycling is halted. The overall control then starts the battery in the original timing sequence which avoids power consumption peaks.

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Auto-Hydrolysis of Barium Filtrate. F. A. HOGLAN, of Glenview, Illinois, U.S.A., assr. INTERNATIONAL MINERALS & CHEMICAL CORPORATION. **2,799,704.** 13th April 1955; 16th July 1957.—Thin filtrate from the barium saccharate process, at a pH below 11 (10·0), is stored and maintained at 55–95°C (75–95°C) until the glutamic acid mother-substances have been partially hydrolysed. It is then concentrated at a temperature between 50°C and the reflux temperature to a dry solids content of 40–80% by weight (45–75%), whereby hydrolysis is completed and the glutamic acid can be recovered. The preliminary hydrolysis and the concentration of the filtrate may be carried out simultaneously.

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UNITED KINGDOM

Recovery of Glutamic Acid. INTERNATIONAL MINERALS & CHEMICAL CORP., of Chicago, Illinois. **782,487.** 16th March 1956; 4th September 1957.—Thin barium filtrate of pH 10·0 and of initial temperature 55–95°C (75–95°C) is hydrolysed by storing for 15–120 hr (24–48 hr). During the transfer from the desugaring process to the storage container the temperature drops 5–10° and then decreases to 30–40°C, at which temperature the hydrolysis is 90% complete. The hydrolysate is concentrated by heating and evaporating in vacuo at between 50°C and the reflux temperature (50–70°C) to a dry solids content of 40–80% by weight (45–75%). The pyrollidone carboxylic acid is then completely hydrolysed to glutamic acid, which is recovered by conventional means. Alternatively, the hydrolysate is neutralized to pH 9·0–10·5 with HCl, sufficient methanol being added to precipitate barium glutamate, which is then separated from the hydrolysate, dissolved in water, and barium precipitated with a reagent, e.g. Na_2CO_3, $NaHCO_3$, K_2CO_3, $KHCO_3$, H_2SO_4 or CO_2, forming a water-insoluble barium salt, which is separated. The pH of the resultant solution may be adjusted to 4·5–5·5 and the glutamic acid recovered.

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Production of Pulp or Cellulose. M. P. BHARGAVA, of Saharanpur, U.P., India. **783,608.** 13th April 1954; 25th September 1957.—For production of high-yield, hard bleaching pulp, white liquor containing e.g. 16% alkali (NaOH+sodium sulphide) on bone dry weight of bagasse with 25% "sulphidity" is pre-heated in a pressure vessel to 162°C and then forced under its own steam pressure into a digester containing previously de-pithed bagasse, the ratio of liquor to dry bagasse being 7–8:1. The steam pressure in the digester is then increased to about 100 p.s.i. by admitting high-pressure steam at the top (e.g. of 125–150 p.s.i.) and maintained at this pressure. The temperature of the charge is gradually increased by indirect heating with forced circulation to 162°C in about 1½–2 hr, after which the pressure is reduced to about 45 p.s.i. and the charge is blown into a blow tank for dilution with black liquor from a previous charge, vacuum-washing, screening, and multiple-stage bleaching. It is then pumped to a hydrapulper or Solvay pulper, where it is completely defibrated and pulped at 95–100°C. The pulp is then further processed for recovery of black liquor.

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Recovery of Glutamic Acid. INTERNATIONAL MINERALS & CHEMICAL CORPORATION, of Chicago, Ill., U.S.A. **778,575.** 16th March 1956; 10th July 1957.—A waste liquor, e.g. barium or Steffen's filtrate containing 25–55% (40–50%) of dry solids, is hydrolysed by treating with barium hydroxide at an elevated temperature (65–100°C), and the hydrolysate treated to remove the barium by the action of e.g. CO_2, SO_2 or H_2SO_4, to precipitate an insoluble barium salt, the pH being adjusted to 8·0–12·0 for this purpose. The precipitate is separated and the hydrolysate treated with either HCl whereupon glutamic acid hydrochloride may be recovered, or with H_2SO_4 to pH 3·2 whereupon glutamic acid may be crystallized and recovered.

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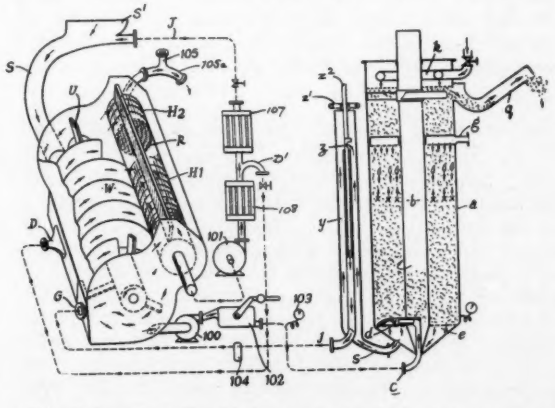
Extraction of Sugar from Beet Cossettes. K. HEINRICH, of Grevenbroich, Germany. **782,651**; **782,652.** 5th January 1953; 11th September 1957.

A scalding trough carries a central tube throughout its length on which are mounted a continuous worm *W* and, at each end, agitator arms indicated at one end by *U*. Cossettes drop into the open end



S' of the pipe *S* which conducts them into one end of the trough in a fluidized state by virtue of hot juice (90°C) *J* entering the pipe *S*. The agitator arms convert them into a substantially uniform mixture of 35% cossettes which is conveyed through the trough

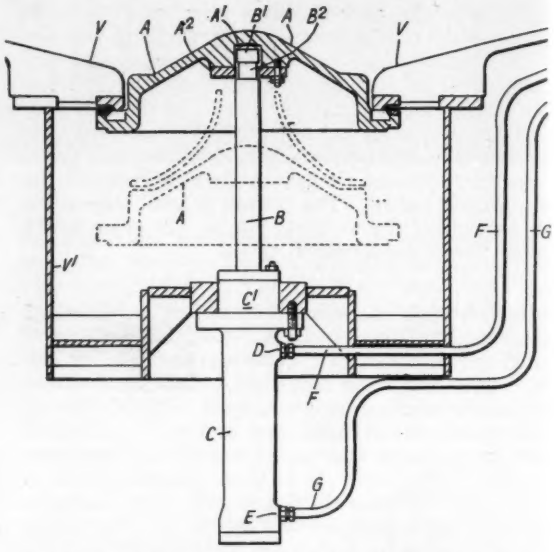
by the worm. The second set of agitator arms then transfer the cossettes, via a cossette pump 100 and a pressure regulator 102 governed by a manometer 103, to the bottom of a tower diffuser *a*, where they are admitted through a cossette distributor *d* mounted on the central rotating tube *b*. The distributor presents a form of wedge shape to the intersurface between the cossettes in the column and the screen *e* so that it lifts the column and fills the space which it leaves behind itself with a fresh supply of cossettes from the trough. Thus the column of cossettes rises continuously through the tower against a counter-current of pulp-free water supplied through pipe *g* to the distributor. A screen at the top of the tower and ejector arms direct the exhausted cossettes into the exit pipe *q* where the level is higher than in the tower to allow drainage. Further sweetening-off the cossettes can be done by pumping condensate through the pipe and distributor *k*. Tower juice draining through screen *e* runs through the conduit *s* into a counter-pressure compensator *y* and thence through the overflow *z* into pipe *j*. The counter-pressure is adjustable by varying the height of the overflow *z* by means of the threaded shaft z^2 raised and lowered by handwheel z^1.

Part of the juice entering the scalding trough at *G*, from pipe *j*, returns to the tower with the cossettes through pump 100, but the remainder displaces richer juice in the scalding trough, which passes into the juice extraction pipe. This is divided into two sections H_1 and H_2 by a partition *R*. The section H_2 receives juice from the freshly-entered cossettes, and this passes to process through pipe 105*a*, while the bulk of the circulation juice passes through the section H_1 into the hollow end-pipe and so via pump 101 to the juice heater 108. Some of the juice passes on through heater 107 and is then used to fluidize the incoming cossettes in *S*, while the remainder is led through pipe *D'* to the port *D* in the trough. The juice extraction pipe rotates in hollow trunnions so that its screen is kept clean by fixed scrapers.

The tower details and operation are covered by Patent No. 782,651, while the trough and its operation are covered by Patent No. 782,652.

* * *

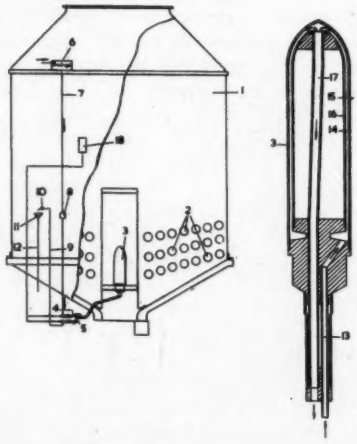
Vacuum Pans. GEORGE FLETCHER & CO. LTD. and C. W. MURRAY, of Derby. **784,227.** 4th November 1955; 9th October 1957.—The discharge valve of the vacuum pan is in the form of a disc valve *A* mounted in the base of the pan *V*, the upper end of a piston rod *B* being connected with the disc valve by means of a receiving socket A^1 for its end B^1 and a securing plate A^2 which locates in the reduced diameter B^2. The lower end of the piston rod is attached to or integral with a piston working in the hydraulic cylinder *C*, its movement being controlled by fluid pressure delivered either through pipe *F* or *G* to the top or bottom of the cylinder. Motion of the piston downwards will cause the valve to open and movement upwards will close the valve. Opening and closing of the valve by this means may be controlled by a lever or electrically, and a pressure regulator



can be used to modify the rate of movement of the valve. The same fluid pressure system may be used to operate valves on more than one pan.

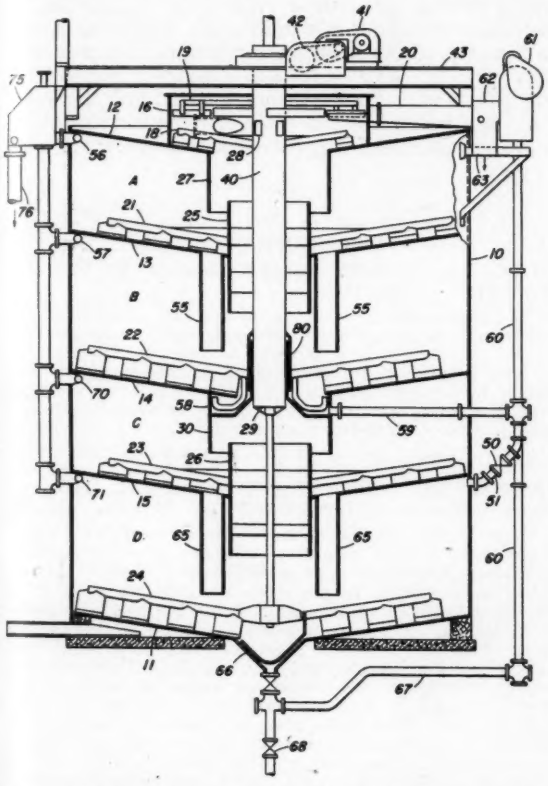
* * *

Pan Boiling Controller. DITMAR ZONEN N.V., of Naarden, Netherlands. **784,458.** 9th September 1955; 9th October 1957.—A double walled vessel 3 is constructed of heat-conductive material and is arranged in the central bottom space of the pan, a constant stream of water being passed via pipe 13 to the annular space 14 between the inner and outer



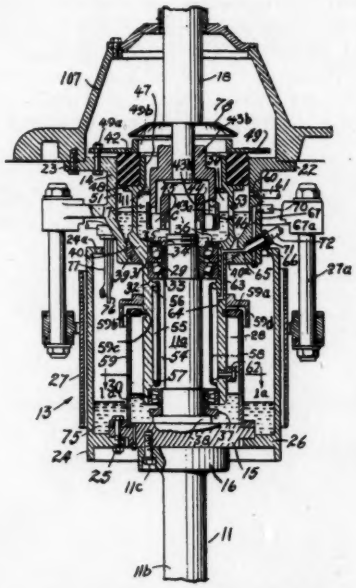
walls 16, 15. The water is discharged via pipe 17, and the temperature of the ingoing and outgoing water measured by thermometers, the difference in temperature being registered by a recording device 18 so that the operator can tell from the trace recorded the circulation and viscosity of the boiling mass and the amount of crystals therein.

Multi-Tray Clarifier. DORR-OLIVER INC., of Stamford, Conn., U.S.A. **784,643.** 15th March 1955; 16th October 1957.—The clarifier tank 10 is divided into four compartments *A* to *D* by transverse trays 13, 14 and 15, having central intercommunicating openings. A feed well 16 is mounted on the top 12, and is fitted with sludge rakes 18 and scum skimmer 19 which removes scum via canal 20. Rake arms 21, 22, 23 and 24 are mounted with 18 and 19 on a central rotating column 40 driven by motor 41 through gearing 42. Feed from chamber 16 enters zone *A* through feed well 27, and enters zone *C* after passage through ports 28 in column 40 and openings 29 into



feed well 30. Rotating feed wells 25 and 26 connect zones *A* and *B* and zones *C* and *D*, respectively. The sizes of units 25 to 30 are critical to the operation of the process. Dirty juice entering feed well 27 is directed partly into zone *A* and partly into zone *B* by feed well 25, which are so designed to give equal entering velocities. Solids settling out of *A* are passed to mud ducts 55 by rakes 21. With mud scraped by rakes 22 in the bottom of zone *B*, they pass into mud boots 58, from which they are drawn, via pipes 59, 60, by pump 61 into sump 62 and outlet 63. Similarly, mud from zones *C* and *D* is collected by rakes 23 and 24 and pass into pipe 67 into pipe 60. Clear juice passes into conduits 56, 57, 70 and 71, and into overflow box 75 and outlet 76.

Centrifugal (Coupling). THE WESTERN STATES MACHINE CO., of Hamilton, Ohio, U.S.A. **784,949.** 6th April 1955; 23rd Ocrober 1957.—The water-turbine driven shaft 18 of the centrifugal is provided with a coupling member 43*b* which has teeth 43*a* which engage with the "crown" teeth 45 on the collar 44 attached to the upper section 11*a* of the driven shaft 11. The design of the teeth is such as to maintain a positive drive while allowing gyratory motion of the driven



shaft, against the resilient pads 42. The driven shaft is supported by a suspension head 13 from stationary hanger 14, the radial and thrust loads being taken by ball races 29 and roller bearings 30. Oil is supplied to the bearings 29 through conduit 61 and passes by gravity to lubricate bearings 30, thereafter collecting in the space between the gyratory sleeve 28 and the annular wall 59. It is picked up by scoop 62 when the machine is running and forced by pressure up the annular chamber 55 and out of the coupling by way of the ducts 64, 63, 65, and so into pipe 71. The drum fastened to the driven shaft by the connexion between the upper and lower halves 11*a* and 11*b* serves as the brake drum of the centrifugal and is acted upon by bands 27 suspended from hangers 27*a*. Cooling water is supplied to the inside of the drum through pipe 76 and is removed by the action of scoop 77.

* * *

Cane Loader. A. MACSPORRAN, of Redbank, Brisbane, Queensland, Australia. **785,402.** 10th November 1955; 30th October 1957.

* * *

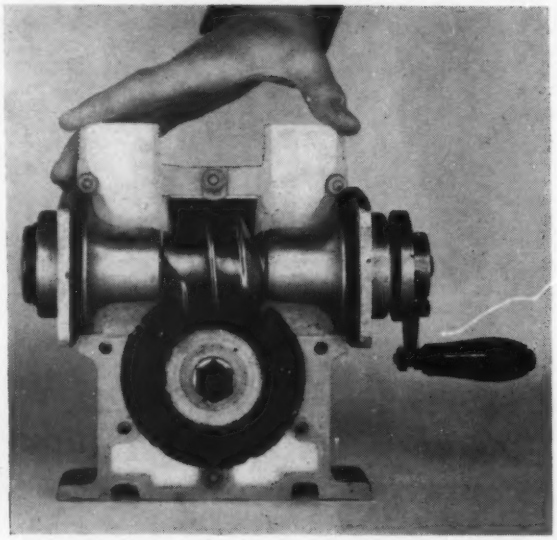
Beet Harvester. W. STOLL, of Peine, Lower Saxony, Germany. **787,443.** 20th December 1955; 11th December 1957.

TRADE NOTICES

Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

The Goodyear Pump. Goodyear Pumps Ltd., Camborne, Cornwall.

The outstanding features of the Goodyear pump are its smallness and lightness for a given duty, and its simplicity. It possesses only two moving parts—the rotor which is in the form of an Archimedean worm, and the plate wheel which engages with the rotor and turns at one-twelfth of the speed. The rotor is mounted on a short rigid shaft, supported in taper roller bearings which are separated from the



inside of the pump by mechanical face seals, a chamber vented to atmosphere, and then by lip seals to exclude foreign matter and to retain lubricant. The rotor is precision-machined and turns within a synthetic rubber stator bonded to a brass plate. The rubber-to-metal joint is lubricated by the fluid being pumped and frictional resistance is virtually nil. The segments of the plate wheel are also rubber-coated and act as worm interruptors, so providing positive action. The symmetry of the mechanism permits pumping in either direction, depending on the direction of movement of the rotor. Construction may be in aluminium alloy, meehanite, or bronze, and it is possible to supply the pumps nickel-plated. For varying duties, the rotor, stator and plate wheel may be interchanged with parts of materials resistant to the action of the fluids being pumped.

The pump has a very wide speed range, but normal running speeds would be 750 to 3000 r.p.m. At this latter speed, the smallest of the three sizes available (weight 8 lb in meehanite) delivers 10 g.p.m. at a 200 ft head; the second size (20½ lb in meehanite) delivers 30 g.p.m. at a 200 ft head; and the largest (124½ lb in meehanite) delivers 155 g.p.m. at a 200 ft head. Corresponding b.h.p. required are 2, 3·2 and 16 b.h.p. respectively. The efficiency of the medium size pump (shown sectioned in the illustration) is 59% at 200 ft head and 61% at 300 ft, so that delivery is still 29 g.p.m. at a 300 ft head. The pressure developed at this head is about 125 p.s.i. and the pump can be used at even higher pressures, while it also develops a suction of 27½ inches of mercury, so that it is continuously self-priming. It will pump mixtures of air and liquids continuously, and can be used on juices, syrups, massecuites (in which no crystal damage occurs), and molasses (which it pumps even at 0°C). It is particularly well suited to overhead irrigation installations.

* * *

PUBLICATIONS RECEIVED

AUTO-LEVEL TABLE. Barron & Shepherd Ltd., 16 Blackfriars Lane, London, E.C.4.

A leaflet describes the Auto-Level Table, which is a container with a spring-compensated platform. As articles are loaded on the platform it sinks so that the top level of articles remains at a predetermined height—the convenient height for the operator. Conversely, when articles are removed from the platform, it rises to maintain the same convenient height. One of the units is operating at a Tate & Lyle refinery.

* * *

GIBBERELLIC ACID. Plant Protection Ltd., Fernhurst Research Station, nr. Haslemere, Surrey, England.

This 35-page booklet gives an account of preliminary experiments over a wide field with the growth-promoting substance gibberellic acid, as yet little known, which is derived from the soil-borne fungus *Gibberella fujikuroi* and which first attracted attention in Japan. It has the unique property of increasing the growth of plants by greatly elongating the cells. Information is here given on the history of its discovery and development and on its biological and physiological properties. A section on suggested experimental uses is intended to focus attention on those crops on which extended trials seem to be most worthwhile. Among these is sugar cane. Suggested uses are for sett-soaking, using a concentration within a range of 10 to 100 p.p.m., and as a foliage spray on young cane. So far sett-soaking (planting setts) has not proved very effective, but further experiment is needed.

* * *

Bookers Acquisition of Duncan Stewart & Co. Ltd.—The Boards of Davy & United Engineering Co. Ltd. and Booker Bros. McConnell & Co. Ltd. announce that Bookers Engineering Holdings Ltd. have purchased Duncan Stewart & Co. Ltd. (Glasgow), which comprises the sugar machinery business of the Davy–United Group. Duncan Stewart & Co. Ltd. will continue to operate, with independent responsibility, under the present administrative, technical and sales staff in charge of sugar machinery; but from new offices at Stewart House, Park Gate, Glasgow, C.3. The ownership of the works and premises at Summer Street, Glasgow, S.E., has been transferred to Davy & United Engineering Co. Ltd., and these will continue to operate as part of the Davy–United Group. Arrangements have been made, however, whereby manufacturing facilities for certain plant will continue to be available for Duncan Stewart & Co. Ltd. at the Glasgow and Sheffield works of Davy & United Engineering Co. Ltd.

U.K. SUGAR IMPORTS AND EXPORTS

BOARD OF TRADE RETURNS

Through C. Czarnikow Ltd., *Sugar Review*, 1958, (338), 22.

IMPORTS (*Long Tons*)	January/December (1957)	(1958)
REFINED	48,560	1,967
RAWS:		
Union of South Africa	108,194	152,934
Mauritius	455,024	413,942
Australia	460,440	299,249
Fiji	83,270	25,043
Jamaica	188,175	234,670
Leeward Islands	55,602	48,189
Windward Islands	9,268	15,290
Barbados	137,466	96,226
Trinidad	125,175	116,165
British Guiana	173,736	124,150
Other British	6,985	1,737
TOTAL COMMONWEALTH	1,803,335	1,527,595
Cuba	447,753	387,989
San Domingo	368,246	369,025
Peru	56,200	41,952
Brazil	135,876	5,586
Other Foreign	15,697	—
TOTAL FOREIGN	1,023,772	804,552
GRAND TOTAL RAWS	2,827,107	2,332,147
EXPORTS (*Long Tons*)		
Cyprus	8,132	10,709
Ghana	31,263	27,567
Nigeria	31,070	46,585
Bahrein, Qatar and Trucial Oman	7,976	8,243
Kuwait	10,467	15,307
India	6	8,045
Pakistan	11	7
Singapore	3,669	11,271
Malaya	30,338	64,781
Other Commonwealth	34,425	57,414
Norway	74,635	54,223
Western Germany	22,880	5,325
Switzerland	62,004	53,627
Greece	250	6,862
Libya	870	14,351
Sudan	40,889	48,031
Lebanon	2,723	5,656
Israel	6,301	1,785
Jordan	3,674	6,300
Saudi Arabia	24,444	6,243
Iraq	61,981	71,303
U.S.S.R.	108,628	—
Other Foreign	110,195	60,089
GRAND TOTAL EXPORTS	676,831	583,724

Nigeria Sugar Possibilities.—Representatives of Booker Bros. McConnell & Co. Ltd. have visited Nigeria to carry out a preliminary investigation to see whether it will be possible to establish a sugar-growing industry on a commercial scale, according to Barclays Bank (D.C. & O.). They have gone to Nigeria at the request of the Federal Government and will cover all three regions of the Federation. The Company has made no commitments to start operations in Nigeria, but if the investigation reveals worthwhile possibilities it would consider embarking on a production scheme. Last year a survey was made by an official of Tate & Lyle Ltd. who reported that the Northern Region holds the best possibilities of a sugar industry because of its soil fertility and communications.

BREVITIES

Sugar in Russia.[1]—Sugar production in the U.S.S.R. has risen from 1,347,000 metric tons in 1913 to 2,523,000 tons in 1950, 3,419,000 tons in 1955 and 4,354,000 tons in 1956. Planned production for the 1957 season is 4,555,000 metric tons from 36 million tons of beet.

* * *

Turkey Factory.[2]—The factory at Adana, mentioned earlier,[3] is to be equipped to produce 14,000 tons of sugar per year from 200,000 metric tons of cane and 12,000 tons of sugar from 100,000 tons of beet. The cane bagasse is to be used as a raw material for the manufacture of packing paper in order to decrease the manufacturing costs for sugar.

* * *

Sugar in Swaziland.—The Government of the Union of South Africa has agreed to the production of 80,000 tons of sugar per year in Swaziland, the British Protectorate between the Union and Portuguese East Africa.[4] In consequence, a scramble for cane lands is going on, and one Natal company is reported to have bought land and to be dismantling a sugar mill near Durban to move to Swaziland.

* * *

Spanish Sugar Industry Expansion.[5]—A Spanish Government decree has set a target of 500,000 metric tons of white sugar for the combined cane and beet sugar industries for the 1958/59 season, which is designed to meet the needs of local consumers. The areas under beet and cane are to be extended so as to guarantee that the target is reached, and the basic price for beet has been increased from 725 to 975 pesetas per metric ton, half of the increase being paid as a subsidy by the Ministry of Agriculture. The price of cane has been increased from 507·5 to 595 pesetas per ton in 1958, both based on a rate of recovery of 8·75%.

* * *

New Guinea Expedition Results.—The U.S. Dept. of Agriculture has stated that the new Guinea expedition[6] brought back cuttings of 150 varieties of *Saccharum officinarum*, 25 different kinds of *S. edule*, and 40 varieties of *S. robustum*. In addition, 61 seed collections were made of *S. robustum* and *S. spontaneum*, and 40 species of related wild grasses were gathered during this, which was the first U.S.-sponsored expedition of its kind since 1928. "When this substantial deposit is screened through quarantine and added to the U.S.D.A.'s collection of sugar cane at Canal Point, Florida, U.S.D.A. scientists will be able to expand studies involving the breeding and selection of better adapted, higher-producing varieties possessing higher sugar content or other characteristics."

* * *

Caroni Ltd. 1957 Results.—In contrast to the previous year, 1957 was a successful crop which yielded excellent results. The main contributory factors were increase in production, abnormally high molasses prices and good labour relations. The high world price only affected 20% of production, the remainder being sold at the Commonwealth "negotiated price". Sugar production amounted to 72,184 tons, compared with 62,318 tons in 1956 and a five-year average of 56,531 tons for 1952–56. For part of the crop, the Esperanza factory (formerly owned by Gordon Sugar Estates Ltd.) continued to operate, but work on the Brechin Castle factory will increase capacity in time for it to handle all the 1958 crop, when Esperanza factory will be scrapped. A profit sharing scheme has been introduced which is designed to encourage regular and steady attendance for work. On the average, a full member of the scheme draws about three weeks' pay at Christmas. The scheme is believed to be the first of its sort introduced in the B.W.I.

[1] *Sakhar. Prom.*, 1957, (10).
[2] F. O. LICHT, *Int. Sugar Report*, 1957, **89**, (Supp. 24), 7.
[3] *I.S.J.*, 1957, **59**, 296.
[4] F. O. LICHT, *Int. Sugar Report*, 1957, **89**, (12), 9–10.
[5] F. O. LICHT, *Int. Sugar Report*, 1957, **89**, (Supp. 24), 6.
[6] *I.S.J.*, 1957, **59**, 167.

BREVITIES

Brazil 1957/58 Sugar Production.[1]—The Brazilian Sugar Institute has fixed the 1957/58 sugar crop at a maximum of 46 million bags (2,760,000 metric tons). Domestic consumption is estimated at 36 million bags, and as 4 million bags are expected to be "dead quotas" of refineries not operating at present, this should leave about 6 million bags for export, if the crop is not affected by drought or frost.

* * *

Indonesian Difficulties.[2]—Production of sugar in Indonesia in 1957 was 820,000 tons, including 650,000 tons of sugar from estate cane. The low production of sugar from smallholders' cane was due to the raising of the sugar excise from 0·27 to 1·27 rupiahs per kilo, which led to the diversion of cane to processing for the excise-free native sugar "Gula mangkok". The excise increase in July 1957 was designed to reduce consumption but was effective only for two months, consumption then rising above the previous level. The new crop is reported to be in danger, as a result of anti-Dutch measures, since, in the absence of Dutch experts it may not be possible to assemble the factory machinery after overhaul in time for the new crop. Further, should production drop, the increasing domestic consumption will mean that there will be less sugar available for export and foreign exchange earnings will decrease.

Stock Exchange Quotations

London Stocks (*at 19th February* 1958)

	CLOSING MIDDLE
Anglo-Ceylon (5s)	11/7½
Antigua Sugar Factory (£1)	20/9
Booker Bros. (10s)	17/1½
British Sugar Corp. (Ltd. (£1)	14/3
Caroni Ord. (2s)	4/–
Caroni 6% Cum. Pref. (£1)	17/3
Distillers Co. Ltd. (6s. 8d units)	19/9
Gledhow Chaka's Kraal (£1)	54/–
Hulett & Sons (£1)	62/–
Jamaica Sugar Estates Ltd. (5s units)	6/1½
Leach's Argentine (10s units)	6/9
Reynolds Bros. (£1)	47/6
St. Kitts (London) Ltd. (£1)	48/6
Ste. Madeleine (Ord.) (£1)	25/3
Sena Sugar Estates (10s)	26/6
Tate & Lyle (£1)	51/6
Tate & Lyle Investments Ltd. (5s)	9/–
Trinidad Sugar (5s stock units)	7/10½
United Molasses (10s stock units)	26/4½
West Indies Sugar Co. Ltd. (£1)	28/9

New York Stocks (*at 18th February* 1958)

	CLOSING MIDDLE $
American Crystal ($10)	30¼
Amer. Sugar Ref. Co. ($100)	25⅝
Central Aguirre ($5)	19
Cuban American ($10)	19⅜
Great Western Sugar	22¼
South P.R. Sugar	27½
United Fruit Co.	42¼
West Indies Sugar Corp. ($1)	66⅝

Sugar Factory for Algeria.[3]—The French Government has published a decree authorizing the construction of a sugar factory in the Affreville region of Algeria, with a capacity not exceeding 60,000 tons of beet per year.

* * *

British West Indies Sugar Association (Inc.).—The headquarters of the Association have been moved from Jamaica and are now located at Barclays Bank Building, Bridgetown, Barbados, West Indies. The telegraphic address is now "BWISUGAR, Barbados".

* * *

New Turkish Factories.[4]—Three new factories are to be built in Turkey which will bring the total in operation by mid–1960 up to eighteen. The sugar output capacity will then be in excess of 420,000 tons a year.

* * *

Argentina Imports.[5]—The severe frosts in Tucumán which caused a drop in sugar production as reported earlier[6] have led to the authorization of sugar imports. The Argentine Central Bank has announced that it will allow the importation of up to 50,000 tons of refined sugar from Czechoslovakia, Denmark, Finland, Hungary, Israel, Poland, Rumania, Russia, Yugoslavia, or neighbouring Latin-American countries. The Bank will allow foreign currency for these imports at the official rate of 18 pesos per dollar up to a maximum of 80% of the cost and freight price.

* * *

Hawaiian Production, 1957.—A total of 1,084,646 tons of 96° raw sugar was produced in 1957 by Hawaii's 27 plantation companies. Production was below that of 1956, when 1,099,543 tons were produced. The all-time record was in 1955 with 1,140,112 tons. The main reason for the drop in production last year was cooler weather during much of the growing cycle of the crop (which is two years in Hawaii). Also, during the early stages of harvesting last year, dry weather allowed operations to move more rapidly than usual. As a result, in some areas younger and lower-yielding cane had to be harvested early. A breakdown of 1957 production by islands is: Oahu 215,981 tons, Kauai 235,436 tons, Maui 238,219 tons, and Hawaii 395,010 tons. Thirteen of the plantations produced more sugar during the past season than in 1956, while the production of fourteen was lower. Four companies, scattered on the three sugar-producing islands, set new all-time records during the year.

* * *

Hawaiian Industry Patents Bagasse Paper Machinery.—A U.S. patent has been granted to the Hawaiian sugar industry on a process for the separation of pith and fibre components of bagasse in the manufacture of high-grade paper. It is based upon research done by scientists of the Experiment Station of the Hawaiian Sugar Planters' Association in a long-range study of the possibilities of using bagasse in the manufacture of quality paper. In the patented process, the bagasse is cooked and subjected to disintegration and screening under action of sprays of water, so the fibre is relatively free from pith and foreign matter. This leaves the fibre in such condition that it is satisfactory for use in the production of various types of high-grade paper, according to the patent application. The patent has been assigned to the Hawaiian Development Co., a corporation handling such matters for the industry, where developments of commercial value result from research financed jointly by all sugar plantations in the Territory. Rietz Engineering Co., of Santa Rosa, California, is licensed to sell machinery using the patented process.

[1] F. O. Licht, *Int. Sugar Report*, 1958, **90**, (Supp. 1), 9.
[2] F. O. Licht, *Int. Sugar Report*, 1958, **90**, (Supp. 1), 12–13.
[3] *Sucr. Franc.*, 1957, **98**, 319.
[4] C. Czarnikow Ltd., *Sugar Review*, 1958, (336), 12.
[5] *Public Ledger*, 11th January 1958.
[6] *I.S.J.*, 1957, **59**, 328.